UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) TACTICAL INTEGRATED AIR DEFENSE SYSTEM		5. TYPE OF REPORT & PERIOD COVERED Final Report 9 June 1978
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Michael C. Press, MAJ, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Student at the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Command and General Staff College ATTN: ATSW-SE Fort Leavenworth, Kansas 66027		12. REPORT DATE 9 June 1978
		13. NUMBER OF PAGES x + 159 (169 pp.)
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Master of Military Art and Science (MMAS) Thesis prepared at CGSC in partial fulfillment of the Masters Program requirements, U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Air Defense
Air Defense Aircraft
Antiaircraft Defense System
Defense System
Integrated Air Surveillance
Integrated Battlefield Control System
Surface-to-Air Defense System
Tactical Air Defense
Tactical Air Defense Applications

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See reverse.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data

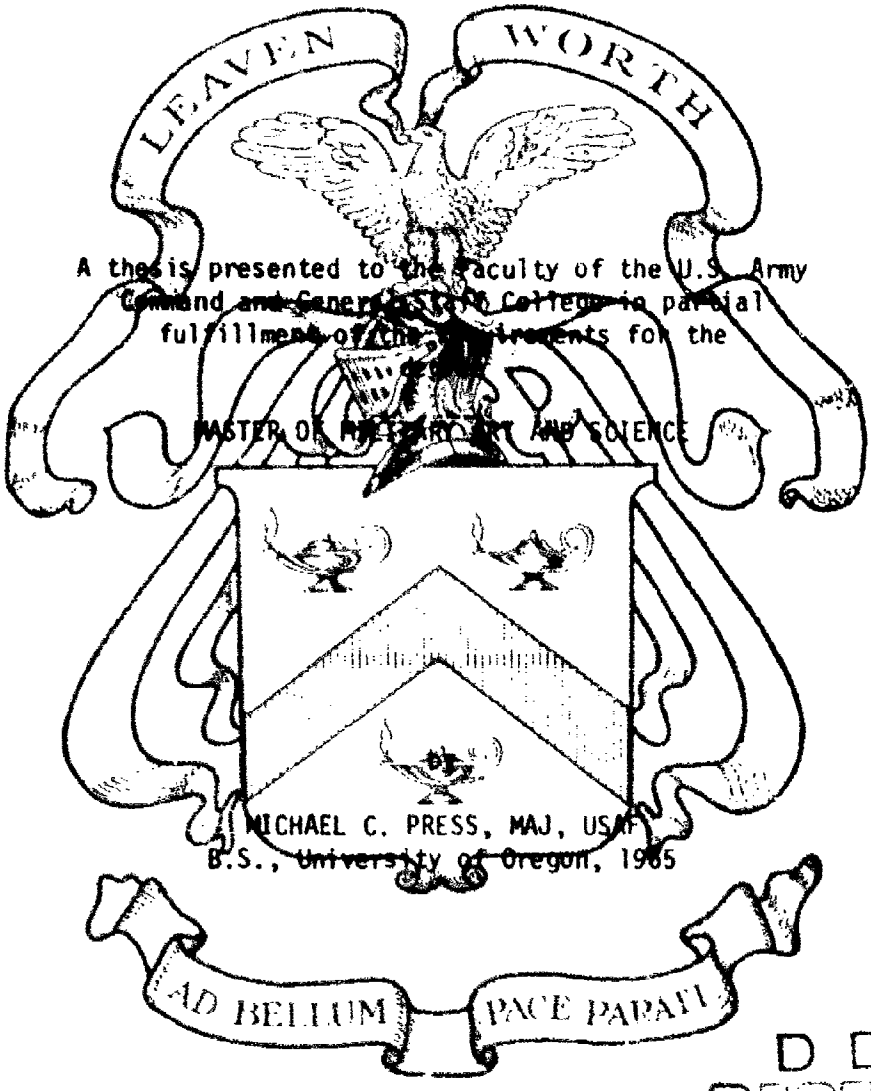
20. ABSTRACT

Several significant events of the past decade have demonstrated the importance of tactical integrated air defense. These events include the air war over North Vietnam, the 1973 Middle East War, and the changes in Soviet offensive tactical air doctrine and capability. These three major events are examined and form the basis for a comprehensive assessment of the present United States tactical integrated air defense system (IADS).

The IADS assessment includes a study of IADS doctrine, organization, methods of control and integration, command and control equipment, weapons, and current joint training. The study concludes that the United States is inadequately prepared to conduct a tactical integrated air defense battle. Major deficiencies in all areas of the integration process are discussed.

Based on the foreseen importance of tactical integrated air defense in future wars and on the deficiencies in the present United States IADS, numerous recommendations are offered for improving IADS capabilities. The recommendations stress the need for increased Air Force/Army emphasis on tactical integrated air defense development in doctrine, equipment, weapons, tactics, and training.

TACTICAL INTEGRATED AIR DEFENSE SYSTEM



A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

MICHAEL C. PRESS, MAJ, USAF
B.S., University of Oregon, 1965

Fort Leavenworth, Kansas
1978

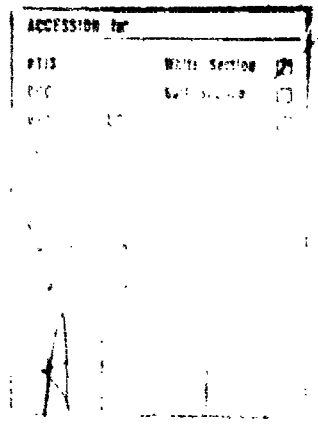
(6) Tactical Integrated Air Defense System,

(10) Michael C. Press, MAJ, USAF
U.S. Army Command and General Staff College
Fort Leavenworth, Kansas 66027

(12) 142 p.

(9) Final report, June 1978

(11) 9 Jun 78



A Master of Military Art and Science thesis presented to the faculty of the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of candidate Michael C. Press, MAJ, USAF

Title of thesis Tactical Integrated Air Defense System

Approved by:

Roger K Taylor, Research Advisor

, Member, Graduate Faculty

, Member, Consulting Faculty

Accepted this 31st day of May by , Director, Master of Military Art and Science.

The opinions and conclusions expressed herein are those of the individual student author and do not necessarily represent the views of either the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

TACTICAL INTEGRATED AIR DEFENSE SYSTEM, by Major Michael C. Press, USAF,

Several significant events of the past decade have demonstrated the importance of tactical integrated air defense. These events include the air war over North Vietnam, the 1973 Middle East War, and the changes in Soviet offensive tactical air doctrine and capability. These three major events are examined and form the basis for a comprehensive assessment of the present United States tactical integrated air defense system (IADS).

The IADS assessment includes a study of IADS doctrine, organization, methods of control and integration, command and control equipment, weapons, and current joint training. The study concludes that the United States is inadequately prepared to conduct a tactical integrated air defense battle. Major deficiencies in all areas of the integration process are discussed.

Based on the foreseen importance of tactical integrated air defense in future wars and on the deficiencies in the present United States IADS, numerous recommendations are offered for improving IADS capabilities. The recommendations stress the need for increased Air Force/Army emphasis on tactical integrated air defense development in doctrine, equipment, weapons, tactics, and training.

ACKNOWLEDGMENTS

I would like to thank Lieutenant Colonels R. K. Taylor and J. M. Littschwager, Major James Sullivan, and Captain James Clements for the constructive criticism and valuable suggestions they made throughout the research and during the preparation of this study. A special word of appreciation is extended to Mrs. Evelyn F. Randolph for her excellent editing, typing, and patience.

M. C. P.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

> . . . Both air force and air defense force [Egyptian] commanders confirmed that, while it was an operational goal to use the MiG-21 as the first force to engage enemy aircraft at maximum range, it also was tactical doctrine for the interceptors to fight within the missile belt and continue harrying attacking forces all the way to their targets. They agreed that losses from friendly missiles were so relatively small that the tactics of using both interceptors and missiles in the same airspace was operationally sound and militarily effective against the offensive formations.[1]

The preceding account of Egyptian air defense operations over the Suez Canal missile belt in the 1973 Yom Kippur War raises significant questions about the United States air defense system. Do the Air Force and the Army have the capability to operate F-15s and I-Hawks in the same airspace? What is the United States air defense doctrine vis-à-vis interceptor and friendly missile integration? Given the United States air defense capabilities, are tactics that use both interceptors and missiles in the same airspace operationally sound and would they be effective against the threat? What are the command and control requirements necessary to operate in a totally integrated environment? These questions and others are answered in this study.

---

[1] Robert Hotz, "Offense, Defense Tested in 1973 War," in Both Sides of the Suez: Airpower in the Mideast, ed. Editors of Aviation Week & Space Technology [New York: McGraw-Hill, 1975], p. 40.

Objectives of the Study

The purpose of this study is to investigate the present United States integrated air defense (IAD) doctrine, tactics, and training. Integrated air defense is defined as the combined efforts of the Air Force defensive counterair resources with the support of Army air defense artillery. The principal objective is to focus on the defensive counterair battle and to analyze the integration of interceptor and ground defense systems. Given the capabilities of the present air defense system, a determination is made on the viability of integrating air defense resources. Finally, changes to IAD doctrine, tactics, and training are recommended on the basis of the conclusions regarding requirements, capabilities, and viability of integration.

Limitations

The Air Force counterair role ranges from active offensive missions against enemy airfields to passive defensive measures such as reinforced hangars. This study is limited to the active defensive counterair mission in an area of operations. Although specific operational areas are not addressed, overseas land tactical operations are the principal concern as opposed to strategic air defense in the Continental United States.

To further limit the scope of this thesis, analysis of the Army's contribution to air defense was narrowed to the integration problem. Army air defense doctrine lists four basic weapons employment

principles: mass, mix, mobility, and integration. The integration employment principle is twofold: first, integration of air defense resources into the ground commander's battle plan and, second, integration of the resources into the battle for air superiority. This study focuses on the second integration employment principle to determine how the Army perceives the concept of integrating air/land defensive resources in a major conflict.

Methodology

United States air defense forces have not been seriously challenged since World War II. Air superiority over United States ground forces was uncontested in Korea and Vietnam. For this reason, United States IAD doctrine, capabilities, and training have not received the scrutiny of extensive investigation and examination. Combined Air Force/Army training exercises continually stress offensive counterair, interdiction, and close air support missions. Because of this reduced historical and operational first-hand experience in IAD, United States military decisionmakers must depend on the IAD experiences of other countries.

In recent wars, North Vietnam, Egypt, and Syria proved to be experts in modern air defense employment. Because of the massive air threats they faced, their air defense systems were highly sophisticated and integrated. The discussion in Chapter II summarizes the effectiveness of their integration experiences.

Any evaluation of current air defense requirements must consider the threat against which it might be employed. Simply determining an enemy's air order of battle does not satisfy this requirement. Other factors such as the enemy's aircraft capabilities, doctrine, tactics, and training must be analyzed to determine joint Air Force/Army requirements. Therefore, to serve as a baseline for evaluating the present IAD capabilities of the United States, Chapter III contains an analysis of the present Soviet tactical air threat.

Given the historical background and operational requirements for IAD, an evaluation of the present United States integrated air defense system (IADS) is presented in Chapters IV and V. In Chapter IV, the evaluation includes Air Force/Army IADS doctrine, organization, and methods of control and integration. Chapter V contains a review of IADS weapons and recent IADS training in combined Air Force/Army exercises. This review illustrates the lack of practical understanding of the air defense integration problem.

The summary, conclusions, and recommendations are presented in Chapter VI. This thesis should provide decisionmakers with additional insight into the air defense integration problem.

CHAPTER II

IADS IN COMBAT

> . . . The American pilots have made a fool of our air force right from the beginning. They think we have only a few outdated jets and dare not intercept them head on. If we do, they will let us have it. So we pretend to intercept, let them pursue us, and lead them into a trap. They have been trapped many a time, because we arrange with the missile troops and Mig-21 units to give them the work.
>
> North Vietnamese MIG-17 Pilot[1]

Introduction

In the past 14 years there have been two major conflicts in the world where modern air defenses played a significant role. In the first conflict, the North Vietnamese, starting from very humble beginnings, built an integrated air defense system (IADS) that battled United States airstrikes off and on for more than eight years. The second major conflict was the 1973 Yom Kippur War. Arab Forces, after being so soundly defeated in 1967, surprised the Israeli Air Force with their air defense effectiveness.

These two conflicts provide the historical base for examining

---

[1]Teramoto Keiji, "The Air Combats I Witnessed in North Vietnam" (pp. 10-11, 44-45, & 93-95 in the magazine Koku Fan, Vol. 20, No. 1, 1971, which the Air Force Foreign Technology Division translated, edited, and repaginated as pp. 1-16, 3 October 1972), p. 7. (DDC Doc. AD 904872L.)

modern air defense integration doctrine in actual combat. The North Vietnamese, Egyptians, and Syrians are the only three countries that have employed missiles and interceptors togetner in actual prolonged combat conditions. It can be argued that Israeli air defenses also engaged targets in the 1973 war, but these proved to be isolated incidents and the Israeli air defenses remained relatively unchallenged throughout the war. The first three countries, however, defended against sustained offensive air attacks throughout the conflicts in which they were involved. Also, their air defenses were challenged by what were possibly the two best offensive air forces in the world.

The North Vietnamese and Arab air defense experiences during their respective conflicts are examined for the purpose of understanding how these countries integrated their missile and antiaircraft artillery (AAA) with their interceptor forces. Their integrated air defense strategy and doctrine are investigated. Specific integration tactics between the interceptors and ground systems are also reviewed. Finally, an evaluation is made on the effectiveness of their integrated air defense systems. These two conflicts are discussed separately and are followed by a comprehensive conclusion.

North Vietnam Air War

The first air war in which the surface to air missile (SAM) was employed in combat was the air war over North Vietnam. Before studying the North Vietnamese IADS, it is necessary to describe briefly the long air war and the North Vietnamese defensive strategy.

Three major United States air campaigns called Rolling Thunder, Linebacker I, and Linebacker II comprised the air war in North Vietnam. Rolling Thunder officially lasted three years, from 2 March 1965 to 31 March 1968, although the first airstrikes in North Vietnam actually occurred on 5 August 1964 in retaliation for the Gulf of Tonkin incident.[2] Rolling Thunder ended when President Lyndon Johnson declared a bombing halt above the 20th parallel in an attempt to get Hanoi to the peace table. In the 3 years of bombing during Rolling Thunder, more than 350,000 sorties were flown over the North and 915 fixed-wing planes were lost to the North Vietnamese air defenses. The North Vietnamese claim they downed more than 3,000 planes in this operation; however, their claim includes aircraft losses from all causes, plus pilotless drones. In fact, more than 1,200 aircraft were lost to "non-hostile" actions throughout Vietnam during these 3 years.[3]

From 1968 to mid-1972, bombing operations in the North were limited to sporadic retaliatory attacks on missile and gun sites. Then, on 8 May 1972, President Nixon began Operation Linebacker I, which lasted until 23 October 1972. Although the targets in Linebacker I were similar to those in Rolling Thunder, the development and use of the "smart" bomb and advanced weapon systems dropped the daily sortie rate

---

[2]U. S. G. Sharp and W. C. Westmoreland, Report on the War in Vietnam (Washington: Government Printing Office, 1969), pp. 12-16.

[3]Jon M. Van Dyke, North Vietnam's Strategy for Survival (Palo Alto, Calif.: Pacific Books, 1972), pp. 240-41 & 248.

by approximately one-third that of Rolling Thunder. The air-to-air war in Linebacker I, however, was larger than in Rolling Thunder. MIG losses totaled 69 (59 in the air and 10 on the ground) during the 6-month operation, compared to 112 MIG kills in the 3 years of Rolling Thunder.[4]

The bombing halt of 23 October 1972 lasted less than two months. From 18 to 29 December 1972, Linebacker II, the most intense bombing campaign of the entire war, was conducted. It was an all-out air offensive designed to break the war-making capability of the North Vietnamese.[5] During those 12 days, more than 4,000 sorties were flown over North Vietnam and at times more than 200 aircraft crowded the skies above Hanoi. Attacks took place around the clock, with B-52s and F-111s flying night-time raids.[6] Enemy air-to-air attacks were minimal because of poor weather, night-time raids, and F-111 attacks on MIG airfields. Only 32 MIGs were launched during Linebacker II, and 8 of them were shot down.[7] United States losses during Linebacker II totaled 26 aircraft:

---

[4]"Airpower Provides Viet Leverage," Aviation Week & Space Technology, 30 October 1972, p. 12; and Van Dyke, pp. 243-44.

[5]U.S., Congress, House, Committee on Appropriations, Subcommittee on Department of Defense, Briefings on Bombings of North Vietnam, Hearings, Committee Print, 93d Cong., 1st sess., March 1973, pp. 4 & 14-15. (Congressional Information Service, Microfiche H181-1.)

[6]Frank Giusti, "Linebackers of the Sky," in Guide for Air Power Case Study: Linebacker I and II, Area III, Course 1975-76, Instruction Period 3107, ed. William B. Hill (Air War College, Department of Military Strategy, n.d.), pp. 86-89.

[7]U.S., Congress, pp. 4, 11, & 38.

15 B-52s, 5 Air Force fighters (including 2 F-111s), and 6 Navy planes.[8]

When Linebacker II ended, the United States began its final disengagement from Vietnam. The air war in North Vietnam was over. The unclassified number of sorties flown in the eight years over the North Vietnamese defenses is difficult to find, as is the exact toll of aircraft losses. Unofficial sources indicate that the total number of aircraft shot down over the North was about 1,700.[9] Regardless of figures, the North Vietnamese obviously became extremely experienced at air defense.

Air Defenses

The North Vietnamese air defense system that challenged the American bombing became recognized as one of the greatest air defense systems of modern warfare. As Major General George B. Simler stated, "The air defense system in North Vietnam is the most formidable and sophisticated our aircrews have yet encountered in any conflict."[10] General John P. McConnell, former Air Force Chief of Staff, referred to the North Vietnamese defenses as "the greatest concentration of antiaircraft weapons that has ever been known in the history of defense of any

---

[8] U.S., Congress, p. 5.

[9] "Antiaircraft Defense in North Vietnam" (pp. 55-71 in the magazine Norsk Artilleri-Tidsskrift, No. 3, 1974, which was translated and repaginated as pp. 1-18 by Leo Kanner Associates, Redwood City, Calif., 30 September 1975), p. 16. (DDC Doc. AD B009853L.)

[10] George B. Simler, "North Vietnam's Air Defense System," Air Force/Space Digest, May 1967, p. 81.

town or any area in the world."[11]

This powerful North Vietnamese air defense system grew from very humble beginnings. In late 1964 the North Vietnamese had only 84 aircraft (30 trainers, 50 transports, and 4 helicopters), 700 conventional antiaircraft guns, and 20 early warning radars of limited capability. They had no SAMs. Defenses were limited to population centers and military installations and were restricted to altitudes below 20,000 feet.[12] The warning system during the early days of the war was primitive. One eyewitness observed: ". . . When a plane was spotted, word was spread either by radios and telephones or by less sophisticated methods, such as whistles, gongs, triangles, and drums. . . ."[13]

From this austere beginning, the North Vietnamese defenses grew into an awesome force. By the end of Rolling Thunder, March 1968, there were more than 8,000 AAA weapons. Among them were 37mm, 57mm, and 100mm radar guided cannons that were capable of attacking aircraft up to 40,000 feet altitude.[14] The Soviet-built SA-2 SAM system was introduced in April 1965. The first successful SAM firing on 24 July 1965 downed an F-4C aircraft. During Rolling Thunder, more than 300 SAM sites were identified and more than 5,500 SAMs were launched.[15] MIG-17s, MIG-19s,

---

[11]Simler, p. 82. [12]Sharp and Westmoreland, p. 13.

[13]Van Dyke, p. 65.

[14]Sharp and Westmoreland, p. 48; and Van Dyke, p. 64.

[15]Sharp and Westmoreland, pp. 18 & 48; and Van Dyke, p. 60.

and MIG-21s were integrated into the defenses, and by late 1968 more than 150 MIGs were operating from bases such as Peitum Yunnani in Southwest China and Phuc Yen and Gia Lam in North Vietnam.[16] Their warning system was modernized and expanded to provide extensive overlapping coverage from the Gulf of Tonkin to Laos. It included altitude discrimination with height finders, and more than 350 radars were operating in North Vietnam. Admiral U. S. G. Sharp, the wartime commander in the Pacific, said in reference to the North Vietnamese defenses:

> . . . The radar net was evaluated as having the capability to detect and track aircraft above 1,500 to 2,000 feet and the net was also probably sufficiently sophisticated to maintain continuity of tracking and coordinate air defense even under pressure of multiple penetrations. GCI [ground-controlled intercept] radars provided control for jet operations in the Haiphong-Hanoi-Thai Nguyen areas, and, for a time, in the southern Panhandle in early 1968.[17]

During the four-year bombing halt between Rolling Thunder and Linebacker I (1968-1972), the North Vietnamese increased their capability even further. A total of 2,500 SAMs were fired in Linebacker I, and more than 1,000 were fired in the 12 days of Linebacker II. MIGs increased in number to a total of 250.[18] One of the most significant developments of this period was the integration of the North Vietnamese radar system, as explained in the excerpt that follows.

> Late in 1971, North Vietnam worked out and executed the integration of all of its radar systems. . . .

---

[16]Van Dyke, p. 62. [17]Sharp and Westmoreland, p. 48.

[18]"Antiaircraft Defense in North Vietnam," pp. 8 & 12; and U.S., Congress, p. 30.

> The essential link in the system was the interaction between the sector radar stations and the local missile batteries' target tracking radars. . . .
>
> By coupling these systems together, the missile batteries were warned earlier than they had been previously, so that the missiles were ready to be fired before the attacking planes had arrived. Eventually all of North Vietnam was covered by a cohesive radar network.[19]

Integration Tactics

As evidenced by the record, the North Vietnamese had ample time to develop and refine their air defense strategy. Although they relied primarily on the antiaircraft gun, integration of their small fleet of MIGs into the overall defense system became quite ingenious. The MIG tactics changed throughout the war, but basically the North Vietnamese strategy was to employ the MIG to complement the other weapons in an integrated air defense.

General William W. Momyer, wartime commander of the 7th Air Force and Tactical Air Comman', reflecting on how the MIG tactics varied during the war and how they affected American tactics, wrote:

> . . . During the early part of the war, F-4s carried bombs and were assigned targets in the same general area as the F-105s. . . . In addition, the MiG threat was very low so there was no need to sacrifice the bombing potential of the F-4. As the MiG threat increased and as the enemy radar system improved, it became necessary to take the F-4s out of the strike role and use them exclusively for air-to-air combat. . . .
>
> . . . The enemy realized that the bombing attacks were doing the real damage . . . . In order to stop these attacks, the enemy positioned the MiG-17s, which had good maneuverability, along the

---

[19]"Antiaircraft Defense in North Vietnam," p. 15.

> ingress routes of the F-105s. These MiG-17s would be held at specific points at a very low altitude.
>
> As the F-105s would start to boost their speed up for the final leg into the target and just prior to the heavily defended SAM ring, the MiG-17s would pop up and try to force the F-105s to jettison their bombs. . . .[20]

The tactics described in the preceding passage demonstrate the coordination that must have taken place in the air defense network. Another recounting by an F-105 pilot of Operation Rolling Thunder further emphasizes this point.

> Generally, however, you could see steady improvement in their defense coordination and as you moved down the Ridge you would go through a definite Mig area where the Sams, although they might be actively operating their radar, would not be firing. Once you broke through that quadrant, the Sams would start filling the air. The ground fire was always present during this phase and in the area of the target itself. As soon as you came back up off the target, you would usually find the Migs shunted in against you, and you would have to fight your way back out. . . .[21]

Although specific integration tactics are difficult to find, research indicates that the North Vietnamese relied basically on a geographical and time separation between their MiGs and SAMs. A highly centralized command and control network directed the integrated tactics.[22] By the middle of Rolling Thunder, Admiral Sharp was concerned about the integrated tactics effectiveness. He said:

---

[20]William W. Momyer, "Momyer Cites Viet's Tactical Lessons--2," Aviation Week & Space Technology, 4 June 1973, p. 59.

[21]Jack Broughton, Thud Ridge (Philadelphia: J. B. Lippincott Company, 1969), p. 106.

[22]Cecil Brownlow, "North Viets Intensify Combat Capabilities," Aviation Week & Space Technology, 8 July 1968, p. 14.

> During 1966 MIG aggressiveness against our strike forces increased from an average of only one engagement per month in the first half of the year to an average of about 12 per month during the last half. Interference by MIG's on numerous occasions served to force strike aircraft to jettison their ordnance in order to engage the attacking MIG's, or to evacuate the area. An increasingly effective air defense effort was evident as coordination between fighters, SAM's, antiaircraft artillery, and radar elements improved. . . .[23]

Late in the Rolling Thunder campaign the MIG-21 began appearing more frequently. It engaged the Americans with a new tactic of close control intercepts with hit-and-run attacks. As General Momyer related:

> . . . The increased deployment of SAMs, greater concentration of AAA, better integration of radars and an increased number of MiG-21s made these new tactics feasible. With a small fighter force, it was necessary that it be under very close control and that it be committed to battle only when the situation was most favorable. . . .[24]

The extremely coordinated air defense network plus the MIG tactics proved successful, for no MIGs were reported lost to friendly defenses. In the unclassified literature examined, the only mention of possible interference appeared in the two extracts below.

> . . . [Migs] could hose a missile at you, but if you keep [kept] thundering, they couldn't quite get the edge they wanted. It must have been frustrating to them, and I had one Mig-21 who got so wrapped up in trying to shoot me down that he made us a flight of five and even stuck in there as I pulled up and rolled in on the bomb run. It was not until the massive ground fire from his compatriots engulfed us that he realized he was in sort of a stupid spot and got out. . . .
>
> . . . . . .
>
> . . . [W]ith the Migs, Sams and guns well coordinated, the defense was probably as intense as the Northern forces could muster and the Migs were particularly active. They would orbit in a

---

[23] Sharp and Westmoreland, p. 27.

[24] Momyer, p. 59.

> specific area and you would have to fight first through them and then through the Sams. The Migs would stay pretty well dispersed so as not to soak up the Sams, but there have been occasions when the Migs have not done their homework too well and have wound up right in the middle of their own ground fire.[25]

Yom Kippur Air War

In the 1973 Middle East War, the Arabs did not overlook the lessons of Vietnam. The humiliating defeat the Arabs suffered in 1967 and the long War of Attrition from 1967 to 1970 convinced them that a strong air defense system was a prerequisite for victory. By the summer of 1973, only six months after Linebacker II ended, the Arabs had developed their version of an integrated air defense system.

Before examining the Arab system and integration procedures, recapping chronologically the events that occurred prior to and during the 1973 air war is also important. The roots of the October 1973 air war strategy go back to the debacle the Arabs suffered in the 1967 war. The Israeli Air Force (IAF) won the war almost by default, because the IAF's surprise preemptive air strikes defeated the Arab air forces and defense forces in the first few hours of the war. The War of Attrition, which culminated in deep Israeli air strikes in 1970, convinced the Egyptians that a stronger and more effective air defense was required.

Air Defenses

The Soviets were asked to help stop the Israeli bombings and build a strong defense. In February 1970, the Soviets sent the first

---

[25] Broughton, pp. 72 & 106.

SA-3 SAMs to Egypt, and by July 1970 more than 10,000 Soviet air defense advisors were in the country. Included in this force were MIG-21Js that were flown by Soviet pilots.[26] The success of the Soviet buildup began to pay off and IAF losses began to mount. In the six weeks before the August 1970 War of Attrition cease fire, IAF losses equaled those of Egyptians at six apiece. Prior to this and since June 1967, the Egyptian loss had been 110 aircraft to 16 for the Israelis. The War of Attrition cease fire came before the Israelis could realize the effects of a modern air defense system.[27]

Egyptian generals have called the War of Attrition a valuable training exercise. One of them said:

> We did not start to prepare our forces from scratch. We knew the enemy whom we were charged to confront; we had greatly benefited from actual contact with him during the War of Attrition from 1967 to 1970. We carefully analyzed the combat actions during this period. We were able to acquire a complete knowledge of the enemy's methods and tactics. We unceasingly watched and followed up all the new developments in Israel's Air Forces until our enemy became an open book before us. . . .[28]

Another said:

> The War of Attrition was in fact a practical experience for our Air Forces which restored to us our self-confidence. One of the

---

[26] Insight Team of the London Sunday Times, The Yom Kippur War (Garden City, N. Y.: Doubleday & Company, Inc., 1974), pp. 35-36.

[27] Ibid., pp. 42-43.

[28] Mohamad Aly Fahmy, "The Role of Egyptian Air Defence in the October/73 War," in Military Sector, Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings [ed. Ahmed Ali M. Amer] (Cairo: Ministry of War, 1976), p. 86.

> lessons from which we gained experience was that our pilots discovered the Israeli air combat methods and their ways of infiltrating through the gaps of our air defence.[29]

The period between 1970 and 1973 was a time for regrouping and further rebuilding. Prior to July 1972, when Egyptian President Sadat expelled the Russians from Egypt, there were more than 15,000 Soviet missile technicians in the country. Also, there were 50 SA-2 and SA-3 sites and between 100 and 200 MIG-21J and SU-11 pilots in Egypt.[30] On 3 May 1973 Syrian President Hafez Asad made a 24-hour visit to Moscow and returned with Soviet Air Force Commander Marshal Kotakhov and a promise to complete the Syrian air defense system with SA-6s and an additional 40 MIG-21s.[31]

At the start of the 1973 war, the completed Arab air defense network was impressive. The initial order of battle prior to hostilities showed the IAF outnumbered almost two to one (see Table 1).[32] The

---

[29]Mahmoud Shaker Abdel Moniem, "The Role of the Air Force in the Operations of October 1973," in Military Sector, Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings [ed. Ahmed Ali M. Amer] (Cairo: Ministry of War, 1976), pp. 130-31.

[30]Insight Team of London Sunday Times, p. 56; and D. K. Palit, Return to Sinai: The Arab Offensive, October 1973 (Dehra Dun, New Delhi: Palit & Palit, 1974), p. 26.

[31]Insight Team of London Sunday Times, p. 72.

[32]Stig Lofgren, "Missiles Against Tanks and Aircraft," in Military Sector, Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings [ed. Ahmed Ali M. Amer] (Cairo: Ministry of War, 1976), p. 103; Palit, pp. 54, 69, & 91; and Strategic Survey, 1974 (London: International Institute for Strategic Studies, 1975), p. 15.

TABLE 1.--Pre-1973 Hostilities Air Order of Battle

Aircraft	Egypt	Syria	Aircraft	Israel
MIG-21	210	200	Mirage	35
MIG-17	105*	80	F-4	100
SU-7	80	30	A-4	160
TU-16	25	0		
Total	420	310	Total	295

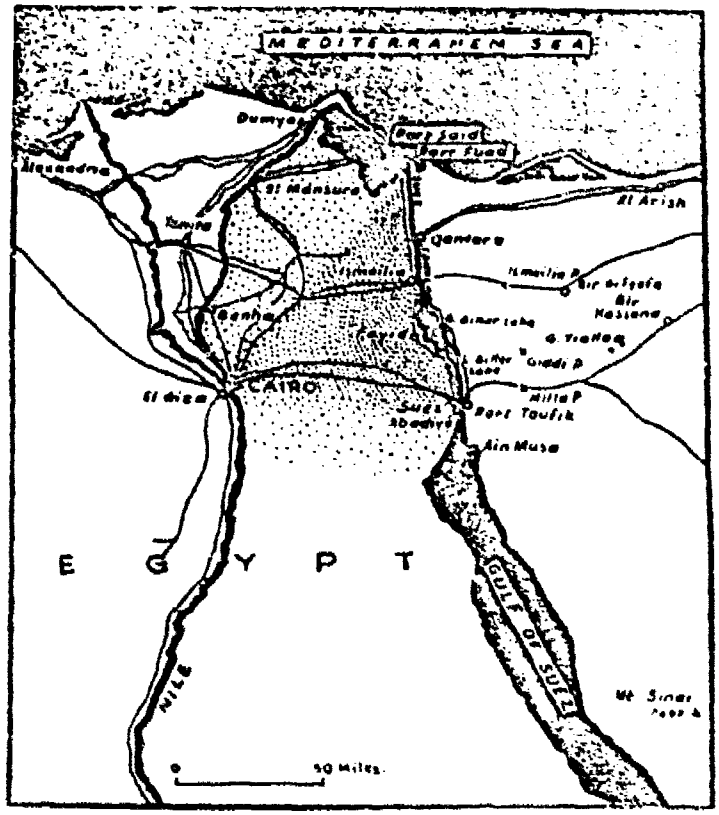
*Approximate figure; 6 to 7 squadrons.

SOURCES: Stig Lofgren, "Missiles Against Tanks and Aircraft," in Military Sector, Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings [ed. Ahmed Ali M. Amer] (Cairo: Ministry of War, 1976), p. 103; D. K. Palit, Return to Sinai: The Arab Offensive, October 1973 (Dehra Dun, New Delhi: Palit & Palit, 1974), pp. 54, 69, & 91; and Strategic Survey, 1974 (London: International Institute for Strategic Studies, 1975), p. 15.

ground defenses were even more impressive. Egyptian air defense forces, under the command of Major General Mohamad Aly Fahmy, had completed an interlocking system of missile batteries. This system represented a triangular shaped defensive pocket with its apex at Cairo and its base stretching from Port Said to the city of Suez (see Fig. 1).[33] In this triangle were some 158 batteries of SA-2s, SA-3s, and SA-6s complemented by SA-7 and ZSU-23 units. Along the Suez Canal alone there were 62 missile batteries that included 46 SA-6 batteries.[34]

[33]Palit, p. 27.

[34]Chaim Herzog, The War of Atonement, October 1973 (Boston: Little, Brown and Company, 1975), p. 256; Insight Team of London Sunday Times, p. 189; and Palit, pp. 69-70.



SOURCE: D. K. Palit, Return to Sinai: The Arab Offensive, October 1973 (Dehra Dun, New Delhi: Palit & Palit, 1974), p. 27.

Fig. 1. Density of SAM Cover Over Egyptian Territory

In Syria the missile defense was not as dense, but it was just as deadly. Prior to the war, the Syrians were deployed along the front line with 32 SA-6 batteries and approximately 22 SA-2 and SA-3 batteries. They also possessed the SA-7 and ZSU-23 guns.[35]

The air defense forces described above replaced North Vietnam's air defense system as the world's most dense employment of antiaircraft equipment. As Israel's Moshe Dayan stated:

> . . . I doubt whether there is another place in the entire world that is protected by such a dense array of modern missiles. I doubt whether there is a place in Russia or Vietnam that is equipped like the Arab front--and, chiefly, the Egyptian front at the canal.[36]

The Yom Kippur War lasted only from 6 to 22 October 1973. It began at 1358 hours on Saturday with a massive Arab air attack on Israeli positions. The Egyptian strike consisted of 220 aircraft attacking interdiction targets in the Sinai. The commander of the Egyptian Air Force, Air Lieutenant General Mahmoud Shakei Abdel Moniem, provided the following list of targets that were damaged in this strike:[37]

3 primary runways	2 major command centers
3 secondary runways	1 telecommunications center
12 Hawk sites	2 radar stations
2 field artillery positions	

---

[35]Herzog, p. 254; and Insight Team of London Sunday Times, p. 189.

[36]Insight Team of London Sunday Times, p. 189.

[37]Robert Hotz, "Offense, Defense Tested in 1973 War," in Both Sides of the Suez: Airpower in the Mideast, ed. Editors of Aviation Week & Space Technology [New York: McGraw-Hill, 1975], p. 38; and Moniem, p. 133.

The initial Syrian attack consisted of 100 aircraft which concentrated on low level strafing and rocket attacks on front line Israeli troops, as opposed to deep interdiction targets.[38]

Following the initial offensive air attacks, the Arab air forces were employed primarily on the defense throughout the remainder of the war. Major General Binyamin Peled, the wartime IAF commander, estimated that 80% to 90% of the Arab fighter force was allocated to the air defense role during the war.[39]

On 6 October 1973 the IAF struck hard at the bridges across the canal and also at the Syrian first echelons that were breaking through on the Golan southern flank. The Israelis, however, were surprised at the extremely stiff and effective air defense resistance. The employment of the SA-6 and ZSU-23 especially concerned the Israelis. In the first afternoon alone, the IAF lost 30 A-4s and 10 F-4s to SA-6 and ZSU-23 defenses on the Golan Heights.[40]

On 7 October the IAF mounted a major air attack on Egyptian air bases and SAM sites in the Nile Delta. The Egyptian air defenses were ready. Sixty MIG-21s were launched to meet the attack, and a massive

---

[38]Herzog, p. 257; and Insight Team of London Sunday Times, p. 133.

[39]Binyamin Peled, "The Air Force in the Yom Kippur War: Main Moves and Lessons," in Military Aspects of the Israeli-Arab Conflict, ed. Louis Williams (Tel Aviv: University Publishing Projects, 1975), p. 242.

[40]Insight Team of London Sunday Times, p. 161.

air battle ensued. ". . . The MIG-21 formations attacked the Phantoms first to get them to jettison their bombs. The Israelis made a determined penetration, and the air battle swirled through the air defense force missile belt to the airfield target areas."[41] The Egyptians later claimed that not one aircraft on the ground was destroyed and that the air bases were repaired quickly. Smaller IAF attacks occurred on 8 and 9 October 1973, but after 9 October they were stopped completely due to poor results and higher priorities elsewhere.[42]

By 8 October the Israelis had already diverted most of their air strikes to the Golan Front in an attempt to blunt the Syrian offensive. Even though the IAF losses were tremendous (about 1 A-4 shot down in every 12 sorties), the IAF was credited with saving the Golan Front.[43] The IAF losses during the first 3 days were put at 50 to 80 aircraft, more than one-third of its forces.[44]

On 9 October, in retaliation for Frog attacks, the IAF began air strikes against strategic targets in Damascus. This was also an IAF attempt to tie up Syrian air defense forces in Damascus and prevent the Syrians from resupplying SA-6s to their depleted missile batteries on the Golan Front. After 9 October, the air war in the north stabilized with IAF air superiority over the Golan and IAF sporadic interdiction

---

[41] Hotz, p. 39. [42] Hotz, p. 40.

[43] Insight Team of London Sunday Times, pp. 182-83.

[44] Palit, p. 157.

missions deep into the heart of Syria.[45]

From 9 through 13 October 1973, the IAF fought an intense air battle over Port Said. Experts are still unsure of why the IAF conducted such a major effort at knocking out the missile batteries at Port Said, because no major ground battles were fought there once the IAF was successful. The Egyptians claimed the IAF lost 28 aircraft to interceptors, missiles, and guns in this battle.[46]

By 15 October, Israeli General Ariel Sharon began the final battle of the war when he crossed the Suez Canal and began attacking Egyptian SAM sites on the ground in the vicinity of Seversoir. Due to this threat, on 18 October the Egyptians released their air force for full-scale defensive operations. For the first time since the air battle on 9 October, Egyptian interceptors began fighting inside the missile belt. In the following four days the Egyptian Air Force fought 18 major air battles with air-to-air engagements that ranged up to 50 aircraft and lasted more than 40 to 50 minutes. The Egyptians launched more than 2,500 sorties in one week. Israel claims that during this battle, 200 Egyptian aircraft were lost versus 3 for the IAF.[47]

The war ended on 22 October. As usual the losses on both sides were contested, but the following aircraft losses are close to those

---

[45]Insight Team of London Sunday Times, p. 204.

[46]Hotz, pp. 40-42.

[47]Insight Team of London Sunday Times, p. 376; and Moniem, p. 136.

mentioned in most sources: Egypt, 182; Syria, 165; and Israel, 120.[48] Contradictions also exist regarding the most effective weapon in shooting down Israeli aircraft. The different claims are shown in Table 2.

TABLE 2.--Percentage of Israeli Aircraft Versus Type of Defensive Weapon

IAF Losses Due To:	Arab Claim	Israeli Claim
Air-to-air combat	30%	15%
Missiles	60%	30%
Antiaircraft artillery	10%	30%
Unknown	. .	25%

SOURCE: Stig Lofgren, "Missiles Against Tanks and Aircraft," in Military Sector, Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings [ed. Ahmed Ali M. Amer] (Cairo: Ministry of War, 1976), p. 104.

The Israelis claim that Arab interceptors shot down only 5 of their aircraft and that they made 334 kills themselves.[49] The Egyptian pilots, on the other hand, say they shot down many Israeli aircraft. Perhaps the discrepancy lies in the pride of the Israeli pilots. An Egyptian MIG-21 regiment commander, who said his squadrons accounted for a total number of 22 Israeli kills, remarked that he believed ". . . many Israeli pilots who punched out of their stricken planes reported they had been hit by a SAM rather than shot down by a MiG to salve their

---

[48] Strategic Survey, 1973 (London: International Institute for Strategic Studies, 1974), p. 26.

[49] Herzog, p. 259.

pride."[50] Regardless of the actual figures, the Egyptians at least feel that they regained their self-respect in the battle for air superiority. As General Fahmy explained:

> . . . Despite these great Israeli losses, we believe that the greatest loss it has sustained from the Egyptian Air Defence Forces is the psychological shock to its Air Force High Command and its pilots and the fact that their self-confidence has been shaken. The enemy, two years after the October War, is still doubtful and perplexed about the reasons of his losses in planes. This alone is something for our Air Defence Forces to be proud of. . . .[51]

Integration Tactics

After examining the war, it is evident that the Arab defensive strategy was to rely on the missile belts as their primary defensive weapon. The air forces were given the task of protecting the flanks and providing limited ground support with MIG-17s and SU-7s. This was especially true with the Egyptian Air Force, for it was held in reserve following the initial air strikes and was not fully used until the air battles over the Suez began on 8 October 1973.[52]

Although not as much information is written on Syria's defensive strategy, its air force was aggressive on the Syrian front during the war. For example:

> . . . Syrian (and later Iraqi) MIGs were thrown into the fray with what seemed reckless abandon, but they provided a considerable degree of close support to the ground forces attacking on the Golan

---

[50]Robert Hotz, "Egypt Plans Modernized Air Arm," in Both Sides of the Suez: Airpower in the Mideast, ed. Editors of Aviation Week & Space Technology [New York: McGraw-Hill, 1975], p. 36.

[51]Fahmy, p. 94. [52]Palit, p. 154.

Heights. Furthermore, probably because of a lesser degree of SAM cover than in the Canal Zone, Syrian based fighters remained in the air more often.[53]

Both Egypt and Syria had problems integrating their air forces and their air defense forces. In 1969 Egypt formed a separate Air Defence Force that was similar to the Soviet Union's PVO Strany.[54] Syria, on the other hand, maintained its air defense forces under the Syrian Air Force, which "perhaps resulted in a close though less sophisticated coordination of missile defences and fighter aircraft."[55] The Egyptian air defense system was highly centralized and similar to the network in North Vietnam. A report by Aviation Week editor Robert Hotz after the war demonstrated this centralization. He wrote:

> The heart of the air defense system is the joint command post at brigade level where an air force colonel and the air defense brigade commander sit side by side with the combat situation display and remoted radarscopes. . . .
>
> . . . . . .
>
> Based on the information it gets from its radar troops and forward visual observation posts, the joint command post directs the air battle in the sector covered by its missile battalions and interceptor aircraft.[56]

---

[53]Palit, p. 156.

[54]Robert Hotz, "Battlefield Equation Changes Seen," in Both Sides of the Suez: Airpower in the Mideast, ed. Editors of Aviation Week & Space Technology [New York: McGraw-Hill, 1975], p. 24.

[55]Palit, p. 157.

[56]"Command Strives To Improve Capabilities," in Both Sides of the Suez: Airpower in the Mideast, ed. Editors of Aviation Week & Space Technology [New York: McGraw-Hill, 1975], pp. 20-21.

The Egyptians, as can be determined through bits and pieces of information, relied basically on corridors for integration of offensive operations and geographical separation for integration of defensive operations. During the major offensive interdiction mission the Egyptian Air Force flew against targets in the Sinai on 6 October 1973, corridors or "passways" were made through the missile belt for the bombers. As General Moniem explained:

> The air formations participating in the strike flew at very low altitudes, nearly touching the sand barriers on both sides of the Canal. Fighter bombers and medium bombers guarded by fighters were used in this raid.
>
> The artillery fire preparations started five minutes after the beginning of the air strike. Therefore, the back trip of the planes after bombarding their targets was a difficult operation that was well-coordinated with the command of the Air Defence forces since the time between the passage of each plane and the other through definite passways for the return trip did not exceed a few seconds.[57]

For aircraft returning from close air support missions, the procedure was to circumvent the missile belts. As explained in the account that follows, this procedure was not always successful.

> The inter-locking missile belt on the West bank posed a problem for Egypt's own aircraft too, because it is almost impossible to rely on I.F.F. [identification, friend or foe (radar)] equipment when aircraft come in flying low and at speeds of Mach I and above. The missile radar is not given sufficient reaction time for its "recognition" procedure, hence there is always a danger of aircraft being hit by their own missiles. Rather than lay down a system of "silent" lanes--which the Israeli air force would soon have discovered--it was decided that Egyptian fighters on their way to or back from their missions over Sinai would have to circumnavigate the missile belt. If they strayed into it there were risks of being hit

---

[57] Moniem, p. 133.

by their own missiles. Some aircraft are reported to have been lost on this account.[58]

On the defense, the Egyptian plan was not to employ MIGs inside the missile belt. They would be operated on the flanks or forward or in the rear. This, of course, worked during the early days of the war, but by 18 October 1973 the Egyptians were forced to abandon this strategy. One source used the words below to recount the dilemma the Egyptians faced.

> . . . The only method of ensuring safety for one's own aircraft is to arrange "clear fire" zones through the area--that is, air corridors in which the missile sites have been closed down for certain mutually agreed periods. The danger in this, of course, is that enemy radar surveillance would at once recognise the existence of such corridors and the enemy air force would use them for their own anti-missile offensive. The Egyptians, so dependent on their missile cover, decided that clear-fire zones could not be permitted --a decision which prevented the Egyptian air force from operations over the area except in emergency; and, if used then, they would simply have to accept the risk of being hit by their own missiles.[59]

Of course emergencies did exist whereby the Egyptian High Command was forced to employ MIGs in the missile belt. The results were predictable, but evidently the Egyptians were prepared for them and even admitted shooting down friendly aircraft over the Suez Canal missile belt.[60] There are claims that a total of 58 Arab aircraft were shot down by their own forces.[61]

---

[58]Palit, pp. 154-55. [59]Palit, p. 70.

[60]Hotz, "Offense, Defense Tested in 1973 War," p. 39; and Palit, p. 155.

[61]Herzog, p. 260.

> . . . The whole blame for such losses should not, however, be borne by the Air Defence System alone. It is reported that because of the linear defensive deployment of SAM sites, the disengagement procedures of Egyptian aircraft were at times faulty. Furthermore, in the forward positions on the East bank bridgeheads, ground forces were operating the shoulder-controlled SAM-7s (Strela) missiles: twin-barrelled antiaircraft guns mounted on trucks are also known to have been deployed in the forward areas and manually operated. Since these weapons depend upon identification by the human eye, mistakes during the heat of battle are known to have caused casualties. It is not quite clear how the Russians, who presumably have a higher density of missiles in their air defence system and a greater number of interceptors, have solved this problem. It appears that the Egyptian air force seem [sic] not to have found an answer yet.[62]

Integration problems also occurred on the Syrian side. When the Iraqi Air Force joined the battle, its initial engagements met with limited success. ". . . At least half a dozen [Iraqi MIGs] were promptly shot down by Syrian SAM-6s because their IFF gear . . . could not cope with the rapid switches in the SAMs' radar wavelengths."[63]

Conclusions

The Arab experience in the Yom Kippur War has many similarities to the air war in North Vietnam. Both defenses were built using Soviet equipment, technology, and tactics. Both defenses were attacked using American equipment and technology. The North Vietnamese and the Arabs used prolonged conflicts and cease fires to expand their systems and refine their strategy and tactics. Both defenses used a highly centralized command and control system. This centralization was essential to

---

[62]Palit, p. 155.

[63]Insight Team of London Sunday Times, p. 315.

effective coordination of defensive resources and the use of integration tactics.

Despite these similarities between the North Vietnamese and Arab systems, there were also major differences. The North Vietnamese were given only the SA-2 and the SA-7, while the Arabs were given the SA-2, SA-3, SA-6, and SA-7. The North Vietnamese relied primarily on their vast numbers of antiaircraft weapons, using the SA-2 and MIGs as a high counterthreat to drive the American attackers into the low altitude AAA envelope. The Arabs relied on their SAMs as the primary weapon and used the ZSU-23-4 and the MIGs to complement the SA-2s, SA-3s, SA-6s, and SA-7s. The last major difference between the two defenses concerns the overall strategy of the conflicts. Whereas the North Vietnamese were concerned with a strategic conflict in defense of Hanoi and Haiphong, the Arabs were mostly oriented toward a tactical ground battle. These differences influenced the overall employment strategy of the air defense resources.

The integration doctrine and tactics used by both defensive forces resembled the Soviets' "zonal" defense (see Chapter III, pages 40-41). This is a system whereby MIG interceptors are used in geographical zones outside the effective ranges of SAMs or AAA. The North Vietnamese and the Arabs (especially the Egyptians) used MIGs on the flanks, forward, and/or to the rear of their SAM belts. They also used MIGs to complement their primary defense weapons. This was accomplished by forcing the enemy to react to the MIG threat, thereby exposing

himself to other systems. They also occasionally used the MIGs as bait to drag the enemy into the SAM rings.

The other integration tactic employed in both conflicts was what the Soviets refer to as "single zone" operations. This is where MIGs and SAMs or AAA operate in the same envelope and are separated by altitude or by the control of higher headquarters. The North Vietnamese, who were more centralized and coordinated, used this system quite effectively. The Arabs tried single zone operations, but their results were less productive. The IFF separation was used sparingly and, as the Syrian experience demonstrated, was not an effective means of integration.

The final questions to be answered in the examination of these defenses are how effective was their integration and was it a viable option? In the case of the North Vietnamese, integration tactics certainly proved highly effective. Through selective employment of their limited MIG resources, the North Vietnamese were, at times, able to create havoc with attacking strike forces. The Arabs, on the other hand, had less success with their MIGs. Effectiveness, however, was not always measured by the ratio of air-to-air kills. On the defense, success was measured by defeating the attack. If, as in the case of the Arabs, the enemy was made to drop his bombs prematurely, forced to miss the target, or dragged into a missile belt, the air defense mission was accomplished. Also, due to the multi-mission capability of Western fighters, the more aircraft tied up in the counterair role (escort, MIG

sweeps, and airfield attack), the less these resources were available for ground support. Here, Arab commanders felt they were successful despite their own aircraft losses to friendly defenses.

As for the question of integration viability, both defensive forces had little choice in their employment options. Given the limited offensive characteristics of their air resources (MIG-17 and MIG-21), it was more realistic to construct a workable integrated defense than to attempt offensive counterair operations against the enemy. The offensive capabilities of the enemy also forced these countries into constructing a sophisticated and coordinated defense. The North Vietnamese were highly outnumbered, while the Arabs were suffering from the qualitative inferiority to the enemy's equipment and pilots. These factors forced these countries' air forces into the defensive counterair mission and made the integration of their defensive resources a mandatory requirement.

Thus, it has been seen how integrated air defenses have been employed in the past decade. Different integration tactics have been used in these conflicts with variable success. The primary integration procedure was zonal employment, whereby interceptors and ground defenses were separated by geographical zones. Regardless of the integration procedures employed, a highly centralized command and control system was used. Finally, the decision to employ a defensive counterair strategy was dependent on the offensive capabilities of the belligerents.

CHAPTER III

THE THREAT

> An important role during the period of the fire preparation is accomplished by aviation. The main objectives of the bomber strikes and strikes of fighter-bomber aviation are the enemy means of nuclear attack, control points, reserves, especially tank reserves, radio technical means, and other important objects which are located, as a rule, beyond the field of fire of the artillery. This permits the more rational exploitation of the capabilities of various means of destruction and facilitates the organization of coordination.[1]
>
> A. A. Sidorenko, Colonel, Soviet Army

Introduction

Soviet tactical air doctrine has been updated in the past decade to reflect the offensive character of modern Soviet military strategy. As expressed in the latest writings from leading Soviet military theoreticians, heavy emphasis will be placed on offensive operations, to include surprise, mass, and maneuverability. This doctrine calls for aviation and artillery to provide the massive fire support the offense requires.[2] This is an important change as far as tactical aviation is concerned. Prior to this new doctrine, tactical aviation had been

---

[1] A. A. Sidorenko, The Offensive (A Soviet View) (Moscow, 1970), p. 124. (Translated and published under the auspices of the United States Air Force [1973].)

[2] Ibid., p. 119.

relegated to a defensive posture that was mainly concerned with defensive counterair operations over friendly troops. Past United States planners were confident that Soviet tactical aviation did not possess a capability in equipment or technology to launch a sustained offensive attack. This has all changed, however. Today Soviet tactical aviation has the mission as well as the equipment and technology to conduct offensive operations.

The primary threat to the tactical defensive counterair mission of the United States is the offensive tactical air employment of the enemy. As the enemy's offensive tactical air doctrine and capabilities change, so must the United States defensive counters be reexamined. Prior to evaluating the United States capabilities, an extensive look into the threat must take place.

The Soviet Union is the primary threat to the United States. It is also the major exporter of tactical aviation hardware to America's potential adversaries. Since many countries use Soviet tactical aircraft, doctrine, and tactics, an examination of Soviet tactical aviation will provide the data required for evaluation of United States defensive needs in large scale land operations and small contingency forces. Soviet tactical aviation's organization, doctrine, and tactics are examined in this chapter.

Organization and Doctrine

Tactical aviation in the Soviet Union falls under the purview of Frontovaya Aviatsiya or Frontal Aviation (FA), one of three components

of the Soviet Air Forces. The other components are Long Range Aviation (LRA) and Military Transport Aviation. Additional major aviation forces are in the Soviet Navy and in PVO Strany, a separate air defense service assigned the protection of the Soviet homeland. In certain situations, units from PVO Strany and LRA would support FA.[3]

Frontal Aviation is organized into air armies and deployed with ground units in military districts throughout the Soviet Union and Europe. In wartime, air and ground units are organized under a centralized command known as a Front. Each Front is assigned one or more air armies, with the Front commander (a ground commander) in overall control. The air army commander is normally assigned the role of deputy Front commander, and employment of FA forces is coordinated into the overall battle plan.[4] In addition, the air army staff headquarters and the Front headquarters are collocated for joint planning.[5] Thus, the mission of the air army is to support the ground forces of the Front, with centralized command and control by the Front commander.

Although the organization of FA has remained fairly centralized and rigid over the years, the doctrine for FA employment has changed.

---

[3]Colin Gray, "Soviet Tactical Airpower," Air Force Magazine, March 1977, p. 62.

[4]Department of the Army, Office of the Assistant Chief of Staff for Intelligence, Military Operations of the Soviet Army, USAITAD Report No. 14-U-76 (1976), pp. 235-37 (hereinafter cited as DA, OACSI).

[5]Leslie R. Drane, Jr., "Soviet Tactical Air Doctrine" (Report No. 5894, Air War College, 1976), p. 32.

During the Khrushchev era, FA was assigned defensive operations and Soviet rocket troops were given the mission of tactical nuclear destruction. Aircraft built for FA in that era reflected this strategy, because the MIG-17, the MIG-19, and early models of the MIF-21 were short range interceptors with a limited air-to-ground capability. In the post-Khrushchev era, a more offensive doctrine developed. Frontal Aviation was given the expanded mission of combined arms nuclear suppression along with the rocket troops and LRA. In addition, FA would gain and maintain battlefield air superiority through offensive counter-air operations designed to destroy the enemy's air forces in the air and on the ground.[6]

This FA doctrinal development is a result of the Soviets' recent emphasis on frontal offensive operations. As Soviet military theorist V. C. Sokolovskiy stated:

> In land theaters the mission of armed combat will be accomplished primarily by offense. But this will be done by the Ground Troops, by fronts, including front line aviation, without the direct support of other services of the Armed Forces. . . .[7]

This offensive strategy has required FA to expand its capability to perform the five basic missions of attaining air superiority, suppressing enemy nuclear capability, supporting ground operations, conducting

---

[6]Drane, pp. 50-51; and Friedrich Wiener, The Armies of the Warsaw Pact Nations, trans. William J. Lewis (Vienna: Carl Ueberreuter, 1976), p. 157.

[7]V. D. Sokolovskiy, Soviet Military Strategy, ed. Harriet Fast Scott (New York: Crane, Russak & Company, Inc., 1975), p. 283.

reconnaissance, and conducting tactical airlift operations.[8]

Past United States reliance on multipurpose aircraft, such as the F-4, has allowed the Soviets to satisfy the first two requirements with airfield interdiction. Enemy airfields are a high priority target for FA aircraft as part of the counterair and nuclear suppression campaigns.[9]

Recent reports on FA doctrine give strong indications that initial operations would entail an air blitz conducted against the enemy's air forces and his nuclear capabilities. A massive air offensive, supported by LRA units and strategic rocket troops, would begin with a preplanned surprise attack against enemy air bases, air defenses, nuclear delivery means, logistic installations, and command posts.[10] Egypt demonstrated this type of air blitz on the first day of the 1973 Yom Kippur War.

As described in Chapter II (page 20), Egyptian preplanned air attacks against Israeli airfields, communication centers, and Hawk sites were doctrinally and tactically in line with Soviet strategy. The only drawback the Egyptians experienced in their attack was the lack of advanced Soviet equipment in electronic countermeasures (ECM) and third generation fighter-bombers. Had the Egyptians been equipped with the capabilities of Soviet FA, their air offensive possibly would have been

---

[8]Drane, p. 51. [9]DA, OACSI, p. 243.

[10]DA, OACSI, pp. 232-33.

bolder and longer lasting. Unlike the Egyptians, the Soviet Union FA forces have the capabilities to support their offensive strategy.

Capabilities

Total Soviet FA forces number approximately 5,500 aircraft. Most of the Soviet force, 3,825 aircraft, are deployed in the European districts. Taking into consideration an additional 2,300 aircraft from Warsaw Pact nations, the force in Europe alone is staggering.[11] The numbers alone, however, do not tell the whole story. Capabilities of the FA aircraft stationed in Warsaw Pact countries have been summarized as follows:

> The new Pact aircraft are more sophisticated and more capable than previous Soviet aircraft. Another disturbing aspect is the increase in munitions delivery capability. Warsaw Pact in-place air forces now can deliver in one sortie several hundred percent more munition tonnage over more miles than in 1971. Their nuclear weapons delivery capability is growing commensurately.[12]

Besides longer ranges, higher payloads, and nuclear capabilities, Soviet advancements in ECM technology and avionics are also in evidence in FA aircraft. Laser designators, doppler navigation computers, chaff and flare dispensers, the advanced High Lark radar, and ECM pods are found on many new aircraft. A 1977 special report on Soviet aircraft penetration capabilities concluded that "the Soviets appear more capable of penetrating the NATO [North Atlantic Treaty

---

[11] Gray, p. 63.

[12] George S. Brown, United States Military Posture for FY 1978 (Washington: Government Printing Office, 1977), p. 37.

Organization] air defense network than their potential adversaries."[13]

Advancements in low altitude navigation and penetration capability represent another important improvement in Soviet technology.

> . . . Recent developments have altered the ground attack profile of FA. The new Fencer-A, Flogger-D, and Fitter-C, in that order of importance, give Soviet FA a low-level interdiction capability that previously was missing. . . . With its terrain-avoidance radar and its laser rangefinder, the Fencer-A, flying in a lo-lo-lo mode, poses a novel threat to NATO. . . .[14]

Overall improvements in FA have complemented the changes in Soviet doctrine. Large numbers of aircraft with a greater low altitude penetration capability are the backbone of the offensive strategy. Large numbers of FA aircraft with new capabilities will penetrate the enemy defenses on a broad front.

Tactics

This section deals with the tactics that FA pilots fly. As stated before, the five basic missions of FA are air superiority, nuclear and conventional interdiction, close air support, reconnaissance, and airlift. Each of these missions is discussed separately; however, the fact is that Soviet strategy calls for a combined arms offensive that will include simultaneous employment of all resources.

Air Superiority

The mission of air superiority is divided into two roles:

---

[13]"Can Soviet Aircraft Penetrate NATO's Air Defense?," Electronic Warfare, May-June 1977, p. 62.

[14]Gray, pp. 63-64.

defensive counterair and offensive counterair. The historical role of FA was the protection of the ground forces by defensive operations over friendly territory. Tactics consisted of short range interceptors (MIG-17, MIG-19, and MIG-21) being vectored throughout an attack by a ground-controlled intercept (radar) (GCI). Today, however, with the massive buildup of mobile ground-based air defense systems, FA aircraft have been released from this traditional role and are being used for more offensive operations. In Europe, this has resulted in the combination of non-Soviet air units used in the defensive air intercept mission and Soviet FA forces operating on the offense.[15]

While discussing defensive counterair tactics, it is interesting to note how the Soviets perceive the problem of integrated air defense. As found in their writings and later confirmed by actual Egyptian employment, the Soviets believe in "zonal" deployment. They maintain that one type of defensive weapon system should not limit the application of the other but that, rather, they should complement one another. Their concept is an organization of coordination by zones whereby fighter aircraft operate outside the field of fire of the ground defenses. The fighters are to operate on flanks, forward, or to the rear. They discuss "single zone" operations in which fighters and ground systems operate together. In this case there are two ways of controlling the operation: altitude separation and target distribution.

---

[15]John Erickson, "Soviet Military Capabilities in Europe," Military Review, January 1976, pp. 61 & 64; and Gray, p. 63.

Altitude separation is accomplished by having the fighters operate above the ground defenses. Target distribution is a centralized management of target identification and allocation of targets to the best defensive system.[16] As discussed in Chapter II (pages 25-29), the Arabs tried all three concepts in 1973.

The current defensive counterair strategy of the Soviet Union can thus be summarized as mainly a zonal defense that consists of ground-based systems and interceptors. The ground systems will be the primary defensive weapon. The non-Soviet FA interceptors will be comprised of older aircraft like the MIG-17, MIG-19, and MIG-21. Interceptor regiments in FA air armies are equipped with the newer MIG-23S Flogger-B. These units could possibly be reinforced by PVO Strany aircraft like the TU-28P Fiddler, SU-15 Flagon E, and MIG-25 Foxbat-A. All of the aircraft mentioned will operate under the typical GCI environment.

Offensive counterair operations have traditionally not been a major factor in FA operations. With the doctrinal change discussed previously (pages 35-36), however, offensive counterair operations have become one of the Soviet FA's priority missions. Interdicting the enemy's air bases, disrupting his command and control, and suppressing his air defenses are primary objectives of the initial air blitz. Large

---

[16] T. A. Bordeaux, "Comparison of U.S. and USSR Land-Based Battlefield Air Defense Systems (U)," Report No. RDA-TR-5500-003 (Santa Monica, Calif.: R & D Associates, May 1974), p. 6-16; and Gray, p. 69.

air battles with more than 50 aircraft may occur over the battlefield of the future as they did over the Suez in 1973. The Soviets realize that Western air forces are outnumbered multi-missioned. They also know that if they can engage these forces in large air encounters, the aircraft so engaged will be unable to perform their nuclear or conventional bombing roles. These air battles will not be GCI controlled. They will be more like the aerial dogfights of World Wars I and II. As one source explains:

> . . . In a conventional localized conflict, escalation in Western Europe would be inevitable, since attacks against airfields would be against the sites where many of NATO's nuclear weapons are stored. The emphasis on the struggle for aerial superiority has thusly evolved to the air space over the battle area, according to Warsaw Pact planners in recent years. This essentially has meant a return to the "classical" form of aerial combat where air superiority (at a minimum over the combat zone) is the objective. . . .[17]

Besides the Soviet counterair interdiction campaign, which should be the major concern for United States air defense planners, FA offensive counterair missions also will include the tactical fighter sweep. Soviet writers explain sweep operations as fighter aircraft missions that are designed to intercept low-altitude enemy jets without the aid of GCI. These missions are not representative of classic Soviet operations; however, Soviet tacticians have not overlooked lessons that may be learned from Vietnam and the Middle East. A study on Soviet tactical air literature includes the following statement:

. . . Although Soviet resources note that ground-controlled

---

[17]Wiener, p. 158.

> intercept has become the rule, it is also pointed out that there is still a place in air combat for tactical fighter operations which rely primarily on visual means of search and detection, such as independent fighter sweeps and the countering of low-flying targets.[18]

The text of the same study notes: ". . . Indeed, some Soviet writers assert that it is 'essential to train all fighter pilots in sweep tactics,' because this may prove to be the only means available 'in complex battle conditions.'"[19]

Fighter sweep operations as practiced in FA exercises consist of the following tactics:[20]

1. Operating several pairs of fighters together, without GCI control in visual search operations.

2. Establishing search zones by flying fixed patrols over friendly territory or beyond the forward edge of the battle area, with air superiority.

3. Flying the straight leg of the patrol pattern at right angles to the probable attack. This is done for better visual and/or on-board radar detection.

[18]Thomas W. Wolfe, "Recent Soviet Literature on Tactical Air Doctrine and Practice (U)," Report No. RM-6336-PR (Santa Monica, Calif.: RAND Corp., July 1970), pp. vii-viii.

[19]Ibid., p. 57.

[20]Ibid., pp. 55-59. (Although this information is pre-1970, my personal opinion is that the Soviets have given sweep tactics more than a cursory glance. Their recommendations for visual search and sweep tactics are the same as the ones Aggressor Pilots at Nellis Air Force Base use. The procedures for Aggressor Pilots were developed late in 1976, after many Red Flag operations in which low altitude non-GCI intercepts were practiced.)

4. Flying missions at medium altitudes. There is, however, one account of a "new method" whereby the fighter operates by alternating between flying at very low altitudes and zooming to great heights.

5. Keeping the sun at the side of the attacker's heading when the sun is low, 20° to 30° to the horizon. Searching toward the sun if the sun is high, which illuminates the target better and makes it easier for the pilot to see the shadow of a low-level attacker.

6. Employing variable speed: high speed for fast low-altitude targets; medium, "economical speed," for slow targets.

Interdiction

Interdiction is another priority mission that is not historically associated with FA. As stated before, it was accomplished by either strategic rocket troops or LRA. With the advent of the new doctrine and third generation aircraft, however, interdiction has taken its proper place in FA planning. The Flogger-D, Fitter-C, and Fencer-A aircraft are specifically built for the interdiction role. Their low altitude, long range, and high payload capabilities make them ideally suited for this mission. These aircraft will be supplemented by older medium bombers from FA and LRA forward deployed units. The YAK-28 Brewer and IL-28 Beagle light bombers are being phased out, but the YAK-28 Brewer-E modified with ECM equipment and the TU-16 Badger-H (LRA) will perform ECM escort duties on interdiction missions.[21] The LRA

[21] "Can Soviet Aircraft Penetrate NATO's Air Defense?," p. 58; Gray, p. 71; and Wiener, p. 160.

medium bombers with ECM escort will supplement the FA interdiction campaign. Aircraft such as the TU-16 Badger-G, which launched Kelt missiles against Israel in 1973, or the TU-22 Blinder-B will be used.[22] Also, the TU-VG-Bomber Backfire-B, which has been introduced into LRA units, possesses an even greater low altitude penetration threat to interdiction defenses.[23]

A widely held belief in Western quarters is that the Soviet interdiction campaign will begin with a massive preplanned "Air Operation." The priority targets will be nuclear strike assets (primarily bomber and fighter-bomber bases), command and control centers, nuclear storage depots, and nuclear missile launchers.[24] It is also generally agreed that this "Air Operation" will be conducted almost exclusively at low altitude and that ECM aircraft and counterair interceptors will participate as escorts.[25] Penetration corridors through the enemy's air defense network will be opened by initial strikes against early warning radars, surface to air missile (SAM) and/or air defense artillery fire control radars, interceptor aircraft on the ground and airborne, and air

---

[22]DA, OACSI, p. 245; and S. W. B. Menaul and Bill Gunston, Soviet War Planes (London: Salamander Books, Ltd., 1977), p. 45.

[23]"USSR, Pact, and PRC General Purpose Force Capabilities," Commanders Digest, 29 April 1976, p. 6.

[24]DA, OACSI, pp. 241 & 245.

[25]DA, OACSI, p. 229; Gray, p. 71; "USSR, Pact, and PRC General Purpose Force Capabilities," p. 6; and Wiener, pp. 157-64.

defense command and control network components.[26]

Low altitude penetration tactics as seen demonstrated in the Middle East War are practiced daily. About 80% of all operational flight training is devoted to low-level exercises and all-weather operations.[27] Six reasons given in Soviet literature for the emphasis on low level, high speed operations are that they:[28]

1. Provide the element of surprise.

2. Avoid radar detection.

3. Reduce the enemy's antiaircraft artillery and/or SAMs and interceptor effectiveness.

4. Assure prompt response to calls for close air support from ground units.

5. Provide for rapid destruction of known and newly detected targets.

6. Make it possible to destroy the enemy's aircraft and missiles on the ground, before they are launched.

Typical interdiction missions are flown at 200 feet and at high speeds. Normal practice during some exercises is to fly the ingress leg at 650 feet to 950 feet over friendly territory and then drop to

---

[26] DA, OACSI, p. 241.

[27] Department of the Army, Foreign Science and Technology Center, "Tactics and Organization of Soviet Ground Forces Different Parts," trans. R. Lagerwerft (Charlottesville, Va., 1974), pp. 22-23 (DDC Doc. AD B001901L); and Wiener, p. 164.

[28] Wolfe, p. 21.

200 feet over simulated enemy areas until the target is spotted.[29] The delivery technique is usually left to the pilot's discretion and depends on the type ordnance carried. Against airfields or highly defended targets, the following procedures apply:

> . . . Where possible, the target should be struck in a single pass at high speed, but if the nature of the target is such as to require action by several groups of aircraft (e.g., a large airfield complex), the successive waves of attacks should be compressed into a minimum period of time and coordinated to come from various directions. . . .[30]

Most weapon delivery methods begin from the low altitude approach. The four basic bombing techniques are low-level approach with pop-up tactics, dive bombing from a medium altitude, level bombing, and the "Yerovikin" method (known in the West as loft bombing).[31] Some typical bombing techniques are shown in Figures 2 through 7. Fighter-bomber units prefer the low-level approach with pop-up tactics, with the recommended maneuver at the top being either the half loop or combat turn. Other recommended tactics in the ground attack delivery mode are:[32]

1. Attack out of the sun.
2. Fly along woodlines and use pop-up delivery.
3. During flak suppression missions, make the first attack against radio-radar installations.
4. During squadron sized attacks, the squadron commander and

---

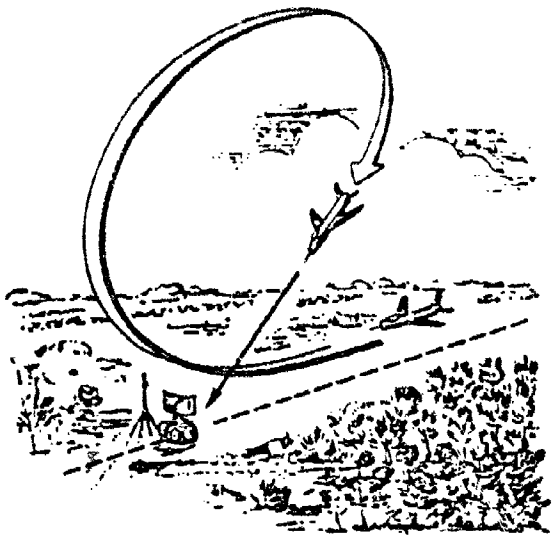
[29] Wolfe, p. 28.

[30] Wolfe, p. 29.

[31] Wolfe, pp. 29-33.

[32] Wolfe, pp. 30-35.

Fig. 2. Attack From a Loop



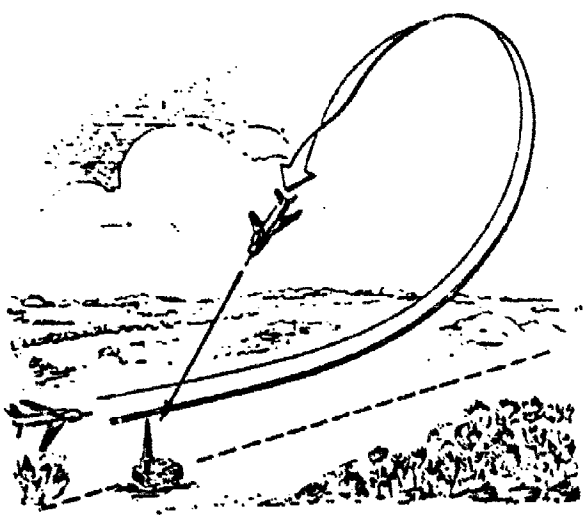


Fig. 3. Attack From a Half-Loop.

SOURCE: Thomas W. Wolfe, "Recent Soviet Literature on Tactical Air Doctrine and Practice (U)," Report No. RM-6336-PR (Santa Monica, Calif.: RAND Corp., July 1970), p. 32.

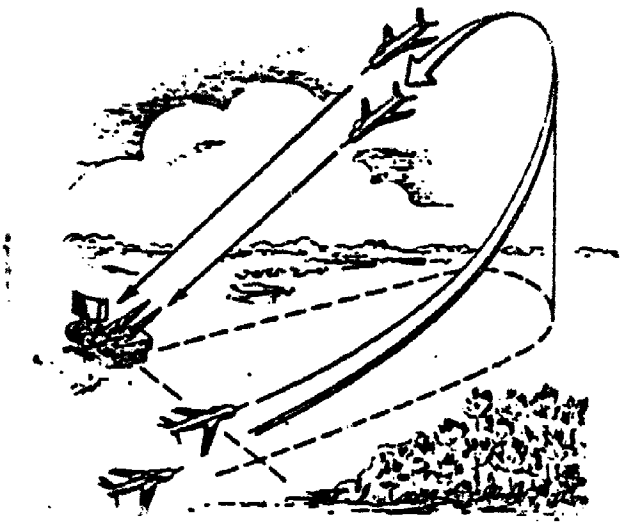


Fig. 4. Attack From a Combat Turn.

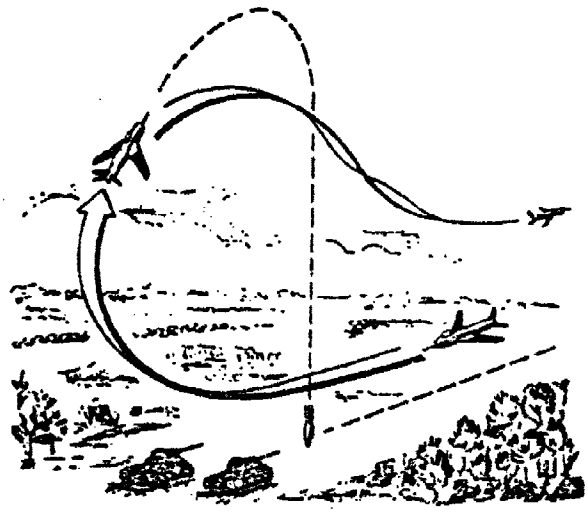


Fig. 5. Bombing From a Climb--"Surovikin" Method.

SOURCE: Thomas W. Wolfe, "Recent Soviet Literature on Tactical Air Doctrine and Practice (U)," Report No. RM-6336-PR (Santa Monica, Calif.: RAND Corp., July 1970), p. 32.

Fig. 6. Attack From Loop and Roll-Off

Fig. 7. Level Bombing After Climb

SOURCE: Thomas W. Wolfe, "Recent Soviet Literature on Tactical Air Doctrine and Practice (U)," Report No. RM-6336-PR (Santa Monica, Calif.: RAND Corp., July 1970), p. 33.

the wingman should make the first attack and should be followed by pairs in tandem at short intervals.

5. Flight leaders attack first, with the wingman flying cover. After the attack, the first pair will cover for the following pair.

6. All attacks will be in two- or four-ship attacks or in spaced pair attacks.

7. Commanders will brief the overall mission, but the attack techniques will be left to the discretion of the pilots.

Close Air Support

Traditionally, close air support as employed by the United States has not been a major mission of Soviet FA. As stated in the U.S. Army intelligence analysis on Soviet ground forces:

> . . . Soviet FRONT Aviation does not normally utilize high performance aircraft to provide close air support along the line of contact except in certain specialized operations and situations such as mountain operations, hasty river crossings, and while supporting penetrations and exploitations which have outrun the bulk of the supporting artillery.[33]

The main mission of close air support in FA is to provide air strikes as an extension of the artillery. There are no airborne forward air controllers in FA as there are in the U.S. Air Force. There is also no direct link between a Soviet battalion commander and his supporting aircraft.[34] Higher headquarters control most targets, which consist of regimental sized targets such as enemy forces on the flanks, enemy reserves, and concentrations of enemy forces at river crossings.[35]

---

[33]DA, OACSI, p. 242. [34]Wolfe, p. 49. [35]Wolfe, pp. 17-18.

Reconnaissance

Air reconnaissance is emphasized as an extremely important FA mission. The principal missions assigned to air reconnaissance units are:[36]

1. Locating enemy missile launchers and weapon depots.

2. Locating enemy airfields and determining preparations for and direction of enemy counterattacks.

3. Uncovering enemy's defensive system.

4. Locating enemy reserves, especially tanks and artillery.

5. Discovering enemy's supply installations and routes.

The aircraft employed by reconnaissance units are the all-weather MIG-21R and MIG-21RF (Fishbed-G/H), YAK-28R (Brewer), IL-28R (Beagle), YAK-25R (Flashlight-D), and the new MIG-25R (Foxbat-B).[37] Penetration routes are at a very low altitude and are carried out to a depth of 50 to 200 kilometers.[38] Specific altitudes vary according to aircraft, equipment, and targets, but generally they are not more than several hundred meters above the ground.[39]

An interesting mission associated with reconnaissance is the mission the U.S. Air Force refers to as strike control and reconnaissance and/or armed reconnaissance. The Soviet version of this mission

---

[36]DA, OACSI, pp. 242-43.

[37]Menaul and Gunston, p. 26; and Wiener, pp. 156-57.

[38]Wiener, p. 157. [39]Wolfe, p. 69.

is explained below.

> In addition to such routine observation by tactical pilots, there is also the use of what the Soviets call "hunter tactics," which amount essentially to armed reconnaissance. Soviet sources place a good deal of emphasis on "free hunt" missions, usually by fighter-bombers, which are intended especially to search out and destroy, or at least to "disorganize" operations of the enemy's nuclear and missile forces.[40]

These hunter/killer flights will either destroy the target themselves or call for reinforcements and mark the target for follow-on flights.[41] Colonel Sidorenko emphasized the "hunter" mission as being effective for nuclear suppression when he said:

> The most effective battle with enemy nuclear missile weapons can be conducted by fighter-bomber aviation employing the independent search and destruction of targets which have been discovered, that is, the "hunting" method. This method of accomplishing the combat mission was widely employed by our aviation during the Great Patriotic War. Now, it will be employed with consideration of the changes which have taken place in the airplanes themselves, their armament, as well as the enemy air defense and the nature of the targets (objectives).[42]

Airlift

The final major task of FA is its support of tactical airlift operations. This role has received increased emphasis in recent years. The Soviets realized in the late 1960s that large airlift operations were essential to taking advantage of offensive nuclear warfare and to capitalizing on nuclear strikes. In Colonel Sidorenko's words explaining the missions and targets of tactical airborne operations:

> . . . Tactical airborne landings will be employed at any time

---

[40]Wolfe, p. 70. [41]Wolfe, p. 70. [42]Sidorenko, p. 136.

> and they will be assigned the most diverse missions: timely exploitation of results of nuclear strikes; capture and destruction of enemy means of nuclear attack, airfields, depots, and other objectives; capture and retention of important positions, crossings, mountain passes; disorganization of troop control and rear area operations; prevention or delay of the approach of reserves from the depth, or of enemy withdrawal, and assistance to troops attacking from the front in destroying the enemy. Tactical airborne landings have an especially important role in exploiting the results of nuclear strikes. . . .[43]

The operations mentioned in the preceding excerpt could entail air assault and airborne missions with transports and troop helicopters. Unit tactical airborne operations are usually associated with motorized rifle battalion sized forces.[44] Of course these operations will coincide with the total offensive and will be supported by other forces. ". . . To assure the landing of a large air-drop at a great depth the enemy air-defense must be neutralized by ECM, air operations, and rocket strikes."[45]

Conclusions

The major air threat to front line tactical forces today is Soviet Frontal Aviation or its exported equivalent. Large in numbers and qualitatively improving, this threat is indeed impressive. Because of its increased capability to strike at deeper targets with larger payloads, Frontal Aviation forces complement the new Soviet offensive

---

[43] Sidorenko, p. 103.

[44] DA, OACSI, p. 244; and Sidorenko, p. 103.

[45] Sokolovskiy, p. 294.

strategy. This strategy calls for a massive preplanned air offensive in the early stages of the war. This attack will be targeted against the enemy's air forces, air defenses, and nuclear capabilities.

The primary tactic to be employed will be low-altitude penetration with electronic countermeasures and air escort support. Large scale reconnaissance and airlift/air assault operations will take place over enemy territory. Independent fighter sweeps and armed reconnaissance "hunting" missions will permeate the forward edge of the battle area. The majority of the air battle, both offensive and defensive, will be fought at extremely low altitudes and high speed.

This chapter has explained the changing Soviet Frontal Aviation doctrine and its implications for the United States defensive counterair capability. Integrated air defense doctrine and procedures must consider the large scale offensive tactics the enemy is prepared to employ. Defensive counterair doctrine should concentrate on defending the priority targets of Frontal Aviation and must be prepared to intercept attacking aircraft at extremely low altitudes and high speeds.

CHAPTER IV

IADS: DOCTRINE, ORGANIZATION, AND METHODS OF CONTROL AND INTEGRATION

Introduction

Vast improvements in Soviet offensive tactical air capability and the new Soviet offensive doctrine require a reassessment of the United States tactical air defenses. The United States, unlike many other countries, still maintains a distinct service separation in its armed forces between air-to-air defenders and surface-to-air defenders. The former are in the Air Force, while the latter are a branch of the Army. The combining of these two separate defensive forces into an integrated air defense system (IADS) is a complex process. Thus the assessment of United States tactical air defense is a difficult task.

To assess the effectiveness of the IADS in countering the threat, the individual capabilities of each service's defensive system must be examined. More importantly, however, the process by which the two services integrate their defensive weapons into the IADS as a whole is of even greater significance. This integration process lies at the cornerstone of the IADS effectiveness question. Individual weapon performance and service defensive interoperability are dependent on how well this integration process works.

Unfortunately, the large and separate service elements that constitute the IADS make the integration processes complex and confusing. Historical service parochialism and individual weapon development have prevented smooth integration. These and other problems have also contributed to doctrinal differences and procedural arguments between the two services. In addition, IADS organizations have grown cumbersome and overly centralized. The two services are beginning to solve many integration problems, but implementing the solutions is difficult and slow.

The United States IADS is explained in this chapter and in Chapter V with emphasis on integration processes and associated problems. Doctrine is discussed here from the viewpoints of both the Air Force and the Army to illustrate how each service perceives the defensive air battle and the role of integrated air defense (IAD). The development of the complex IADS organization and methods of employment is a direct result of historical doctrinal disputes and controversial agreements between the services. These organizations and means of employment are defined in detail to demonstrate conceptual operation of the system. Actual equipment, weapons, and training are discussed in the next chapter for the purpose of determining if conceptual system design meets operational requirements.

Doctrine

Current joint doctrine for integration of air defense weapons was developed in the late 1950s and early 1960s following the Key West

and Newport conferences in which the Department of Defense classified service roles and missions. One of the functions resulting from the early conferences was that the Air Force would develop "doctrines, procedures, and equipment for air defense from land areas."[1] As a result of Department of Defense Directive 5100.1 (31 December 1958) and further guidance in Publication 2 by the Joint Chiefs of Staff in November 1959, the Army and Air Force Chiefs of Staff reached a controversial agreement. This so-called Decker/LeMay agreement was the basis for Publication 8 by the Joint Chiefs of Staff in May 1964, Doctrine for Air Defense From Overseas Land Areas.[2]

Publication 8, which has not been amended or changed since 1964, remains the cornerstone document upon which IAD doctrine is based. The organization for joint air defense operations is doctrinally established in this publication to provide for "centralized direction and maximum decentralized authority to engage hostile aircraft."[3] The centralized commander would normally be an Air Force commander. While this is generally accepted in today's Army manuals, the Army opposed it at the

---

[1]Department of Defense, Functions of the Department of Defense and Its Major Components, DOD Dir 5100.1 (31 December 1958), p. 12.

[2]"Air Defense and Air Superiority," Draft Annex ____ (n.p., n.d.), entire source. (USACGSC Library Doc. N-18090.3. This unpublished draft of an 80-page staff study lists numerous Army arguments against the Decker/LeMay agreements and the proposed Publication 8 by the Joint Chiefs of Staff.)

[3]Department of Defense, Joint Chiefs of Staff, Doctrine for Air Defense From Overseas Land Areas, JCS Pub 8 (May 1964), p. 9.

time.[4] Publication 8 discusses the integration of air defense weapons only briefly, and that is in Paragraph 305, "Effectiveness of Various Air Defense Weapon Systems," which reads:

> The air defense commander must insure, through his organization and application of appropriate procedures, that optimum effectiveness is realized from each of the various air defense weapon systems and that no unnecessary restrictions are placed upon their employment.[5]

Air Force Doctrine

Since the Air Force is given primary responsibility for the formulation of air defense doctrine, an examination of its doctrine regarding the IADS has considerable merit. Unfortunately, no single Air Force doctrinal manual is specifically devoted to tactical air defense. The Air Force interpretation of IAD can be examined only by combining bits and pieces from a number of Air Force 1- and 2-series manuals. The most important Air Force manuals that deal with IAD doctrine are:

1. Basic Doctrine, AFM 1-1, 15 January 1975.
2. Tactical Air Operations--Counterair, Close Air Support, and Air Interdiction, AFM 2-1, 2 May 1969.
3. Tactical Air Force Operations--Tactical Air Control System (TACS), AFM 2-7, 25 June 1973.
4. Tactical Air Operations--Airspace Control in the Combat

---

[4]"Air Defense and Air Superiority," p. 3.

[5]Department of Defense, Joint Chiefs of Staff, p. 12.

Area, AFM 2-12, April 1973.

5. US Air Force/US Army Airspace Management in an Area of Operation, AFM 2-14, 1 November 1976.

Although the dates on most of these manuals are relatively recent, doctrine concerning air defense, sometimes referred to in the Air Force as defensive counterair, has remained basically unchanged since World War II. The Air Force has consistently accorded top priority to offensive counterair, deep penetration, and interdiction missions. Offensive air operations dominated tactical air forces throughout the Korean and Vietnam wars. This offensive strategy has been reflected not only in Air Force doctrinal evolution[6] but also in aircraft development. Air Force fighter aircraft design characteristics stress long range, air-to-air refueling capability to extend range further, sophisticated self-contained navigation equipment and penetration aids, and the ability to carry large weapon loads. Even the F-15, the first Air Force fighter to be used exclusively for air-to-air combat since the F-106, was originally designed as a multipurpose fighter.

The wisdom of this historically offensive oriented tactical air doctrine is being questioned by various elements of America's military society and civilian institutions. For example, a recent news article cited a 1977 Brookings Institute study that urges a reorganization and

---

[6]Charles J. Brown and Johnnie R. Reeder, "The Development of Counterair Doctrine" (Research Report No. 5858, Air War College, April 1976), entire report. (DDC Doc. AD B011161.)

upgrading of America's tactical air defense posture in Europe.[7] Two recent war college studies further highlight the fact that the Air Force has been remiss in defensive counterair doctrinal development. The following excerpt summarizes the concern:

> The possibility that the USAF [U.S. Air Force] might have to operate from airfields which enemy air power actually attacks is glossed over in USAF basic and operational doctrines. . . . There seems to be some irrational expectation that all wars will be fought from sanctuaried airfields. . . .
>
> . . . . . .
>
> . . . USAF doctrine should officially acknowledge the possibility of fighting a defensive air campaign, since that is a possible situation faced in Europe. . . .[8]

The author of the second study questioned the validity of a North Atlantic Treaty Organization (NATO) offensive air strategy. He convincingly concluded that it would be impossible to gain air superiority or to conduct an effective interdiction campaign in a short, intensive European conflict.[9]

Despite these and other warnings, the preference for offensive operations over defensive counterair continues to permeate current Air Force doctrine. Basic Doctrine, a 1977 draft update of AFM 1-1, states

---

[7]Bernard Weinraub, "Air Attack 'Threat' to NATO: West Vulnerable to Soviet Strike, Brookings Finds," Kansas City Times, 30 January 1978, p. 8A.

[8]Claude C. Blanch, "Air Superiority Today and Tomorrow" (Report No. 5847, Air War College, April 1976), pp. 21-22. (DDC Doc. AD B011430L.)

[9]Ray G. Thompson, "An Alternative NATO Air Strategy of Defensive Operations" (student paper, U.S. Army War College, 16 March 1972), pp. 44-48.

that offensive counterair operations "are the most effective means for achieving air superiority and are essential to gaining air supremacy."[10] AFM 2-1 parallels this thinking by stating:

> . . . [U]ntil air supremacy is gained, the emphasis should be on offensive counter air operations. Air defense, while vital to the total counter air program, is a relatively inefficient means of destroying enemy air potential and, by its very nature reacts only when the enemy exercises initiative action. Offensive pressure must be maintained so that the enemy is forced to withhold a significant portion of his air potential for defense of his own area.[11]

While stressing the importance of offensive operations, AFM 2-1 only briefly discusses defensive counterair operations. It reemphasizes the fact that the Air Force has the overall responsibility for integrating the theater air defenses by stating:

> It is essential that a single Air Force commander be assigned overall responsibility for gaining and maintaining air supremacy. Friendly forces assist to the degree that their organic capabilities and efforts can contribute to the success of the counter air task. The AFCC [Air Force Component Commander] is normally designated Area Air Defense Commander and Area Airspace Control Authority. As Area Air Defense Commander his mission is to coordinate and integrate the entire air defense effort within the joint force command. . . .[12]

The manual further establishes that the AFCC has the responsibility to "insure that optimum effectiveness is realized from each of the various air defense weapon systems" and to establish "air defense procedures and rules of engagement."[13]

---

[10] Department of the Air Force, United States Air Force Basic Doctrine, AFM 1-1 (DRAFT) (20 May 1977), p. 21.

[11] Department of the Air Force, Tactical Air Operations--Counterair, Close Air Support, and Air Interdiction, AFM 2-1 (2 May 1969), p. 5-3 (hereinafter cited as DAF, AFM 2-1).

[12] Ibid., p. 5-2. [13] Ibid., pp. 5-2 & 5-4.

Reflecting the designation of the AFCC as the Theater Air Defense Commander, Air Force doctrinal manuals continually stress the need for centralized control of air defense weapons. AFM 2-1 explains it this way:

> . . . Effective air defense requires centralized control of air defense weapons within an area of operations. Control agencies and communications-electronics facilities must provide the means for integrating air defense actions with all other air operations. Adequate early warning and defense in depth should be provided to allow engagement by multiple weapon systems. Identification criteria, weapon assignment procedures, and rules of engagement must be uniform and the activities of strike and support aircraft must be coordinated with air and surface-to-air defense activities.[14]

Although the remaining 2-series manuals briefly discuss air defense, their main thrust is an explanation of the intricate command and control relationships throughout the air defense and airspace management organization. These manuals are based on the premise that "air defense and airspace control are interrelated and inseparable. Thus a coordinated and integrated air defense and space control system under a single authority is essential."[15] This appears to be the basic rationale for the overemphasis on centralized control throughout the IADS organization.

Surprisingly, not one of the manuals under consideration here discusses the basic issue of how an IADS is to operate. Such items as

---

[14]DAF, AFM 2-1, p. 5-3.

[15]Department of the Air Force/Department of the Army, US Air Force/US Army Airspace Management in an Area of Operation, AFM 2-14/ FM 100-42 (1 November 1976), p. 1-1.

IAD procedures, rules of engagement, airspace and geographical control zones, target allocation, and assignment decisionmaking are not even discussed. In summary, Air Force doctrine manuals are historical copies of past offensively oriented manuscripts and they lack the necessary recognition of a changing balance of power. On the other hand and as shown next, the Army has attempted to update its air defense manuals based on the new threat.

Army Doctrine

In 1976 the Army published the first of its new "how to fight" doctrine manuals, FM 100-5. Since then, branches within the Army have published new "how to fight" manuals that include a new series of air defense artillery (ADA) employment manuals. The manuals that concern IADS doctrine are:

1. Operations, FM 100-5, 1 July 1976.

2. U.S. Army Air Defense Artillery Employment, FM 44-1, 26 March 1976.

3. U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3, 30 September 1977.

4. U.S. Army Air Defense Artillery Employment: Redeye, FM 44-23, 30 September 1977.

5. U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90, 30 November 1977.

FM 100-5, the fundamental Army doctrinal manual for operations, lays the foundation for the Army's reliance on the "active defense" and

states that the "first battle of our next war could be its last battle."[16] The Army is basing its doctrine on fighting outnumbered and especting to win a short, intense defensive first battle with the enemy. Throughout FM 100-5 and as taught in the U.S. Army Command and General Staff College, defensive action in a short, intense war will be the primary method of operation for the Army. This defensive Army strategy somewhat clashes with the offensively oriented Air Force doctrine discussed earlier.

Even though the Air Force has been given overall responsibility for integrating air defense, the Army ADA employment manuals address more of the basic IAD doctrinal issues than do the Air Force manuals. Although the Army's general treatment of IAD doctrine is very thorough, some major misconceptions relating to interceptor integration are quite disturbing. To begin, FM 44-1 lists the four basic ADA employment principles. These are weapon mass, weapon mix, mobility, and integration. In describing integration doctrine, the Army manual explains that "air defense artillery weapons must be integrated into the force commander's scheme of maneuver and also into the battle for air superiority."[17] How this integration takes place is further explained by listing the family of weapons and how the weapons are to be used. For

---

[16]Department of the Army, Operations, FM 100-5 (1 July 1976), p. 1-1.

[17]Department of the Army, U.S. Army Air Defense Artillery Employment, FM 44-1 (26 March 1976), p. 5-3 (hereinafter cited as DA, FM 44-1).

instance, short-range air defense (SHORAD) weapons are normally employed in maneuver elements. Low-to-medium altitude air defense (LOMAD) weapons are deployed throughout the division and in the rear areas.

> . . . Manned fighter aircraft complete the family. They seek to strike enemy aircraft on the ground or to engage enemy aircraft well-forward of the FEBA [forward edge of the battle area] to effect maximum attrition and break up concentrated attack formations before they reach elements of the Army in the field protected by ADA.[18]

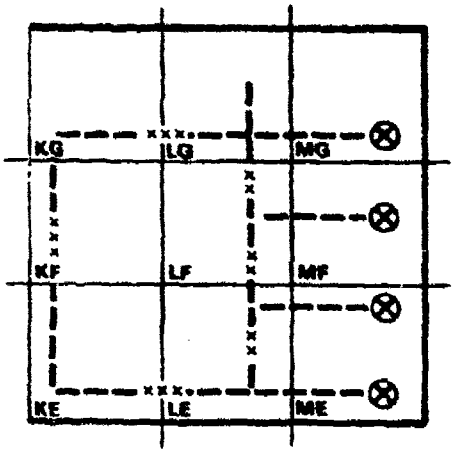
References to the large offensive counterair battle the Air Force plans to fight are seen in the preceding excerpt on fighter employment. Even in the new FM 44-1, the Army's concept of Air Force participation in the air defense battle is that the interceptors be assigned a mission "well-forward" of the FEBA. Unfortunately, "well-forward" of the FEBA is probably the most dangerous and ineffective place for interceptors to be assigned. Not only is the enemy's own ADA most effective in this area, but lack of friendly ground-controlled intercept (GCI) stations, excessive fuel loads, external pod carriage of electronic countermeasures (ECM), and difficult navigation become compounding problems in this region.

Another doctrinal area of concern with FM 44-1 is its explanation of the role of Air Force interceptors in the medium-to-high altitude regime (see Fig. 8). As stated in the manual: "The long-range Nike Hercules system, in conjunction with Air Force interceptors and the Hawk missile system, is employed against the medium- and high-altitude

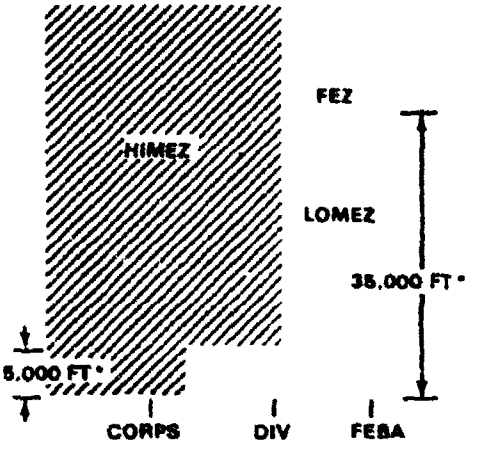
---

[18] DA, FM 44-1, p. 2-5.

- **Fighter aircraft engagement zone (FEZ).**
- **High-missile engagement zone (HIMEZ).**
- **Low-missile engagement zone (LOMEZ).**



GEOREF



*ALTITUDES SHOWN ARE EXAMPLES ONLY.

Weapons engagement zones are defined by horizontal boundaries through the use of the geographic reference (GEOREF) system and by altitude limits.

In this case, the LOMEZ would have been established based on a message, such as:

"LOMEZ established GEOREF squares MG, MF, & ME, 0-35,000 feet MSL; GEOREF squares KG, KF, KE, LG, LF & LE 0-5,000 feet MSL." (Horizontal limits may also be defined by partial GEOREF squares and/or by geographic coordinates.)

SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-13.

Fig. 8. Air Defense Weapons Engagement Zones (Vertical View)

air threat."[19] In a European scenario, the effect of medium altitude employment, coupled with the "well-forward" strategy, places the manned interceptor in the worst possible location for intercepting the primary enemy air threat, which will be low altitude aircraft. Enemy ADA is of even further concern. Overlaying the engagement zone figure of FM 44-1 with the enemy ADA figure from FM 100-5 graphically displays the problem for the interceptor pilot (see Fig. 9).

Despite these major misconceptions concerning interceptor employment, the Army's remaining explanation of IAD employment doctrine is very informative. Momentarily disregarding the location of the engagement zones, Figures 8 and 9 show that the integrated air defense doctrine of the United States as articulated by the Army is similar to the Arab and Soviet "zonal control" (see pages 29-30 and 40-41). Further evidence of this is found in FM 44-1, where it is explained that segregation of air defense weapons is insured through airspace and geographical separation. Weapons engagement zones, restricted areas, and safe corridors are used to solve the fratricide problem. Simultaneous engagement by Hawk and interceptors is considered only under special circumstances and highly controlled conditions.[20]

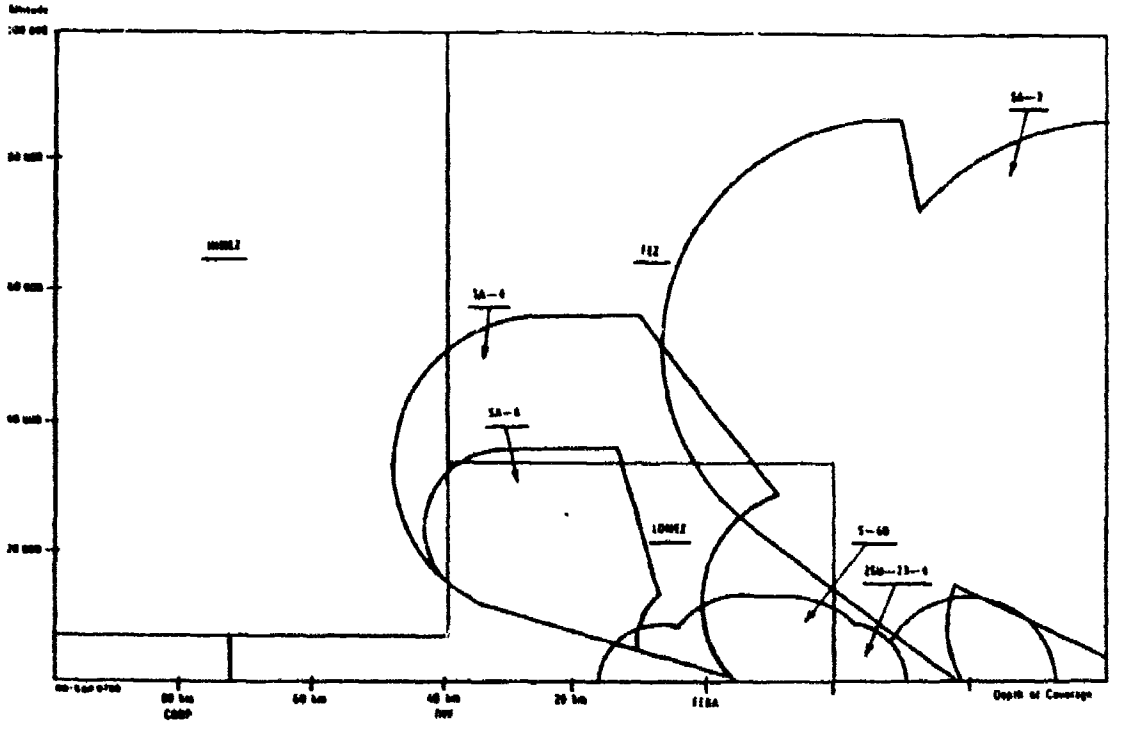
The FM 44-1 discussion of "Hawk belts" and forward missile intercept zones along the borders in Europe hint at the common usage of this zonal control doctrine.[21] This is in fact the case as a 1976 study

---

[19] DA, FM 44-1, p. 5-5.

[20] DA, FM 44-1, pp. 6-2 & 6-3.

[21] DA, FM 44-1, p. 3-7.



SOURCES: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-13; Department of the Army, Operations, FM 100-5 (1 July 1976), p. 8-3; and Department of the Army, U.S. Army Air Defense Artillery Employment, FM 44-1 (25 March 1976), p. 6-3.

Fig. 9. Weapons Engagement Zone Problem for Interceptor Pilots

of NATO tactical air forces explains European IAD doctrine. According to the study:

> In 2ATAF [Allied Tactical Air Forces], fighters conduct a zonal defense in the rear of the Hawk Belt, which lies 80 to 120 kilometers from the Demarcation Line (DL). . . . Since preplanned effective Combat Air Patrol (CAP) positions are behind the Hawk/Nike engagement zones considerable enemy penetration of the forward area will occur before enemy aircraft are engaged by friendly defensive fighters and friendly air superiority will be non-existent in the forward areas.
>
> In 4ATAF fighters defend as far forward as possible to assist the army and to protect key land and air facilities. This levies a requirement to gain and maintain air superiority further forward, consequently, 4ATAF air defense/CAP positions are closer to the DL than similar positioning in the 2ATAF area. The 4ATAF Hawk sites are also situated much closer to the DL and employ a mobile concept, moving to alternate sites during buildup/hostilities. . . .[22]

While the Army ADA doctrine manuals contain major misconceptions in interceptor employment, their general explanation of IAD doctrine and procedures is excellent. Unlike the Air Force manuals, the Army manuals discuss the major considerations of IAD control--weapons engagement zones, geographical control, and other employment problems. Unfortunately, this unilateral state of doctrinal development exists despite directives by the Department of Defense and publications by the Joint Chiefs of Staff that give IAD doctrine responsibility to the Air Force. It appears that the Army, rather than ignoring the problem, has prudently initiated some effort toward developing operational IAD doctrine and the Air Force is reluctant or institutionally opposed to doing so.

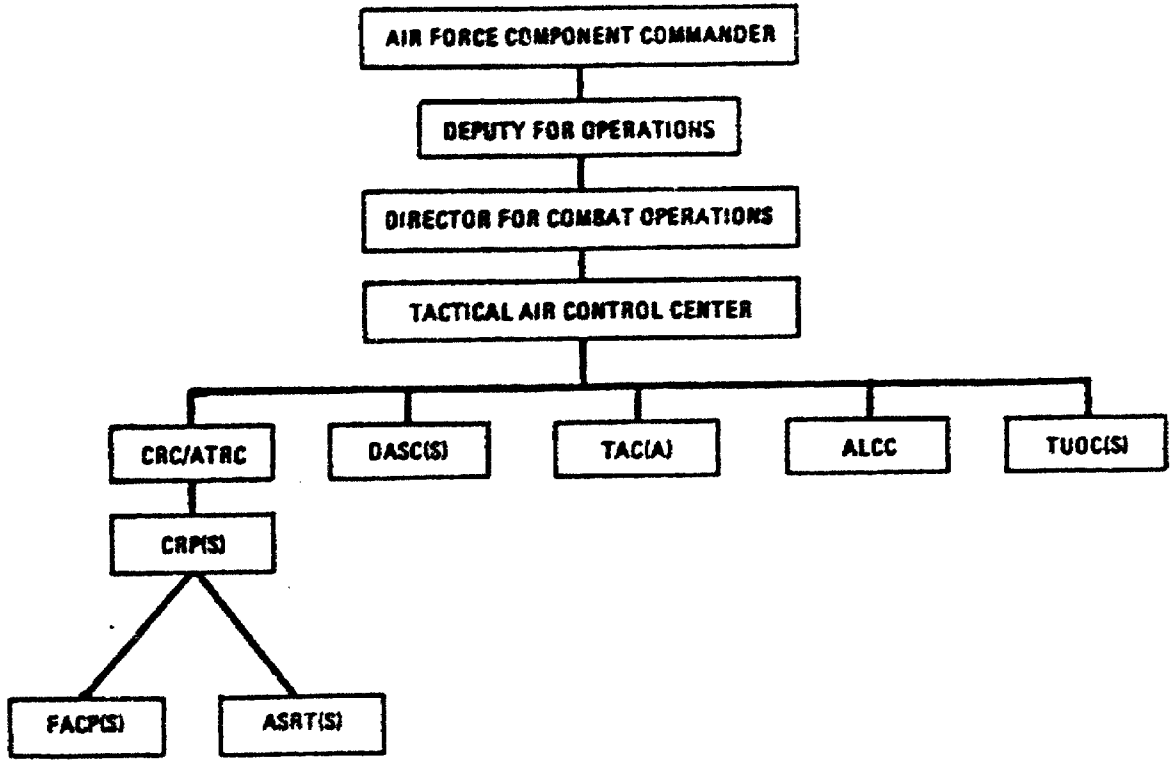
---

[22]Steven L. Canby, "Tactical Airpower in Europe: Airing the European View (U)," Report No. TSC-PD-471-1 (Santa Monica, Calif.: Technology Service Corporation, 19 July 1976), pp. 39-40.

Organization and Lines of Control and Communication

Since the Air Force and Army maintain separate but complementary air defense weapon systems, constructing a simple command, control, and communication (C^3) IADS organization chart is difficult. Often the case is that the IADS command, control, and communication lines do not overlap. Terms such as "command less operational control" are common throughout the organization. As a result and in an attempt to simplify the explanation of how the system works, this writer has concentrated on a description of the important functional weapons control and communication lines throughout the IAD organization. This description focuses on the positions that are responsible for developing and passing the IAD battle plan, weapons rules of engagement, and target assignments. Also explained are the lines of control and communication whereby target information, weapon integration, and firing decisions are passed.

As a brief overview, the tactical air defense organization is based on the doctrinal principle of centralized management and control and decentralized execution. The AFCC, acting as the Area Air Defense Commander, controls all air defense forces through an organization called the Tactical Air Control System (TACS) (see Fig. 10). Through the tactical air control center (TACC), the AFCC permits decentralized control of essential air missions to subordinate TACS elements. The planning for the integration of air defense resources is accomplished in the TACC; however, the actual control of the air defense battle is delegated to the control and reporting centers and posts (CRCs/CRPs).



ADAPTED FROM: U.S. Army Command and General Staff College, U.S. Air Force Basic Data, RB 110-1 (July 1977), p. 5-2.

Fig. 10. Typical Tactical Air Control System (TACS)

At the CRCs, Army ADA weapons are integrated into the system through data link and communication lines to the Army Air Defense Command Posts (AADCPs) (see Fig. 11). An AADCP may be at various echelons depending upon the scale of operations, but it would normally be either at brigade or group level or at Hawk battalion level. The lines of control are then decentralized down to individual Hawk batteries and Chaparral/Vulcan (C/V) battalion AADCPs. Further lines of control and communication exist between the C/V AADCPs and the C/V squad leader and Redeye teams.

Through this extensive system the AFCC exercises centralized operational control of all theater air defense weapons. He does this by implementing rules of engagement and standard operating procedures. This organization looks simple; however, many subtle and some not so subtle problems are associated with it. The lines of control and communication are too centralized and cumbersome to respond to the kind of intense low altitude air battles that were fought in the 1973 Middle East War. Many of the important positions required for IAD planning and control are never exercised. The effectiveness of SHORAD weapons is reduced due to lengthy lines of communication and lack of integration with the Air Force and Hawk early warning radars. These and other problems throughout the IADS organization are expanded upon in the following discussion of the IADS organization from the AFCC down to the Redeye team leader.

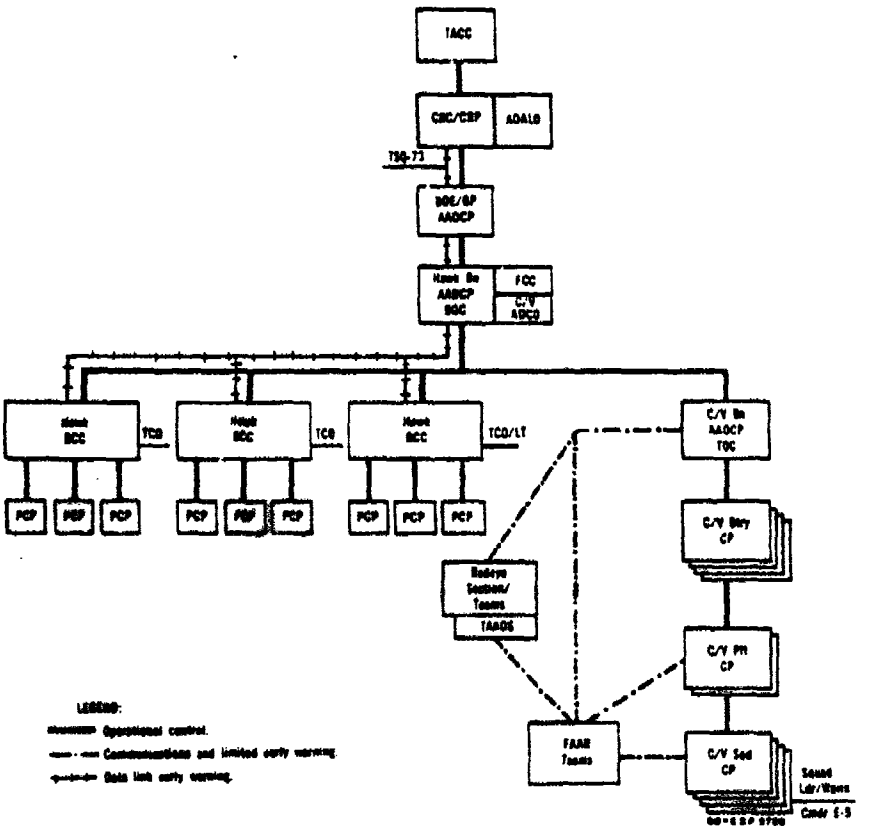


Fig. 11. IADS Lines of Control and Communication

Air Force Component Commander

The centralized management concept requires the AFCC to maintain positive control over all Air Force and Army air defense weapons. He does so by recommending an overall air defense battle plan to the Joint Forces Commander (usually an Army commander). In the battle plan, the AFCC recommends the apportionment of tactical air resources to be devoted to air defense and the rules of engagement for air defense weapons. The apportionment recommendation alone is an important decision. A recent study of a European scenario explained that a simple 10% change in the apportionment of tactical air forces could lead to a 50% increase in the ground area lost by NATO forces.[23]

Although the number of fighters apportioned to the air defense forces is important, an even more important factor that affects the outcome of the air defense battle could be the rules of engagement by which execution of the battle is decentralized to subordinate elements in the TACS. Terms such as "centralized control" and "decentralized execution," "command less operational control," and "operational control of weapons" are common throughout the IADS organization. These terms make the actual weapons engagement control lines confusing to the operators.[24] This confusion factor forces the AFCC to invoke rather strict

---

[23]E. Dews and others, "Tactical Airpower in a Mid-Seventies NATO Defensive Contingency (NATO ALPHA) (U)" (Santa Monica, Calif.: RAND Corp., October 1974), p. xii. (DDC Doc. AD1000156L.)

[24]Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 5-20 (hereinafter cited as DA, FM 44-90).

and universal rules of engagement and weapons control status on all air defense weapons, thereby grossly inhibiting their effectiveness.

Tactical Air Control Center

The air defense battle plan the AFCC proposes to the Joint Force Commander is formulated by the AFCC staff in the TACC. According to TACR 55-45, the individual who is actually responsible for developing the daily apportionment recommendation that the AFCC briefs to the Joint Force Commander is the chief of the Fighter Planning Branch in the Current Plans Division of the TACC.[25]

Also according to TACR 55-45, however, the key individual in the TACC for the development of the IAD plan is the TACS Planning Officer. The regulation states that this individual, who also works in the Current Plans Division and is the chief of the Airspace Management Branch, has the responsibility to:

> Plan for the employment and integration of area air defense weapons systems, including AWACS [airborne warning and control system] and Other Service air defense weapons systems.
>
> Develop policies and procedures for air defense operations. Coordinate and promulgate rules of engagement, and employment directives.
>
> Advise the Chief, Fighter Planning Branch on the recommended employment of fighter aircraft in the defensive counter air role.
>
> . . . . . .

---

[25]Department of the Air Force, Air Force Component Headquarters and Tactical Air Control Center Operations, TACR 55-45 (7 February 1975), p. 6-3 (hereinafter cited as DAF, TACR 55-45).

Prepare briefing of proposed air control procedures and air defense employment plans as required.[26]

In a search for IAD planning considerations, it appears that simply contacting a TACC TACS Planning Officer would yield great insights. In an attempt to do just that, however, it was discovered that the TACS Planning Officer exists only on paper in the Tactical Air Command (TAC). At the two garrison TACCs in the TAC (9th Air Force, Shaw Air Force Base, and 12th Air Force, Bergstrom Air Force Base), only about 10 of approximately 50 positions are permanently filled. The TACS Planning Officer is not one of the garrison positions. In actual deployment, this position would be manned by an Air Force major, senior weapons controller (Air Force Specialty Code (AFSC) 1716/1744). Upon arrival at the TACC as the TACS Planning Officer, he would presumably begin the IAD planning. In most cases, however, the IAD planning would have occurred prior to the major's arrival, because IAD procedures, rules of engagement, weapons control status, and weapons engagement zones appear in contingency or exercise operation plans and/or in supporting operation orders (OPlans/OpOrds). These plans are formulated by planning officers in the Readiness Command and in numbered air forces.

Although the regulation calls for the TACC planning division to build the IADS battle plan, in practice the real IADS planners are the officers who develop the contingency or exercise OPlans/OpOrds. For example, the development of the IADS plans for joint exercises such as

---

[26]DAF, TACR 55-45, pp. 6-11 & 6-12.

Brave Shield and Bold Eagle are accomplished at the Plans Divisions of the 9th and 12th Air Forces. Joint meetings are held with representatives from the TACC, CRC, Army ADA, and fighter wings in attendance. Through these conferences, the plans officers develop and publish the IADS procedures in exercise OPlans/OpOrds. Thus, the TACC/TACS Planning Officer, who is rarely activated for exercises, has little to contribute to IADS planning.[27] As a result, he would be ill-prepared to manage the complex IADS as directed by the regulation.

Control and Reporting Center

The rest of the IADS organization is relatively simple to reconstruct, but it contains ambiguities that are similar to those found in the TACC. The overall responsibility for conducting the air defense battle is delegated to the CRC (see Fig. 12). In the CRC the battle commander (BC) retains ultimate responsibility for IAD employment. The BC is normally the senior ranking Air Force controller (AFSC 1716/1744) in the CRC. He coordinates and establishes operating procedures with the Army Air Defense Artillery Liaison Officer (ADALO), the Weapons Assignment Officer (WAO), and the Senior Director (SD) in the CRC for allocation of targets to ADA and fighter forces. The ADALO and WAO further coordinate with their respective weapons systems for final firing orders. Like the TACC/TACS Planning Officer, the CRC/BC position

---

[27]Telephone conversations with TAC Plans, 9th and 12th Air Forces TACC, 17-19 January 1978.

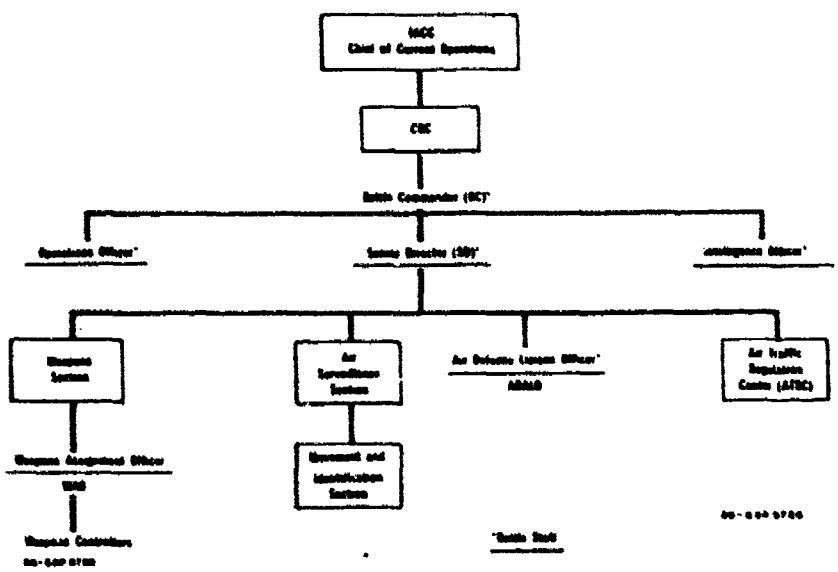


Fig. 12. Control and Reporting Center Chain of Responsibility for Air Defense Operations.

is not manned in-garrison. Normally, the CRC Operations Officer or the CRC Senior Director assumes CRC/BC duties in-garrison.[28]

Army Air Defense Artillery

For Air Force/Army air defense integration, the ADALO is the key individual in the CRC. He coordinates and monitors CRC/AADCP functions and relays IAD procedural changes down the Army ADA chain of control (see Fig. 11, page 74). For the Hawk units, data link and/or manual communication lines are used to exchange early warning information and to designate target assignment. These lines of control terminate in the Hawk battery control central (BCC), where the Tactical Control Officer (TCO), normally a lieutenant, executes the final firing order.

For the SHORAD units, lines of communication from the CRC/ADALO are used only to pass changes to IAD procedures, such as rules of engagement or weapons control status. Air Force early warning information and data link are not normally associated with SHORAD employment. The ADALO relays changes to IAD procedures through the brigade/group or Hawk AADCP where a Chaparral/Vulcan Air Defense Coordination Officer (ADCO) is positioned. The ADCO may also be located in the CRC/CRP when coordination with a Hawk battalion is not possible.[29] The IAD

---

[28]Department of the Air Force, Tactical Air Control System (TACS): Surveillance and Control of Tactical Air Operations, TACR 55-44 (20 March 1975), pp. 7-9.

[29]Department of the Army, U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3 (30 September 1977), pp. 5-6 & 5-7.

procedural changes are relayed in turn by the ADCO to the C/V AADCP and by the C/V AADCP to the individual C/V squad leader/weapons commander (usually an E5 or lower), who then executes the final firing order.[30] Redeye teams also receive these procedural changes through the C/V AADCP channels of control. These SHORAD lines of control and communication rely strictly on voice communication via FM radio nets that are limited by line of sight, short range, and enemy jamming doctrine. Until about 1973, SHORAD units were equipped with the ANGRC-5 (AM receiver only), which provided a credible early warning integration. These receivers, however, were deactivated in 1973, and, as of this time, no suitable replacement has been found.[31] As Air Force early warning and target acquisition are not included in the SHORAD lines of communication, these units use an Army organic forward area alerting radar (FAAR)/target alert data display set (TADDS) system for this function (see Chapter V, pages 109-112).

In summary, the control and communication lines throughout the entire IADS organization are complex and lengthy. For rapid target acquisition and subsequent engagement, this highly centralized organization is slow in responding. Important IAD positions of responsibility in the TACC and CRC are not normally manned, which means that

---

[30]Gordon M. Gershon, "Tactical Air Defense Evaluation Study (TAD-E), Subtask 6--Analysis of SHORAD Weapon Systems: Command and Control Alternatives (U)" (Menlo Park, Calif.: Stanford Research Institute, May 1974), p. 12. (DDC Doc. AD 530688L.)

[31]Personal interview with an Army SHORAD officer, 24 April 1978.

operational training is questionable. In addition, because the SHORAD units are not incorporated into the Air Force/Hawk early warning and target assignment nets, strict SHORAD rules of engagement and weapons control procedures are employed which restrict their effectiveness.

Methods of Control and Integration

The method by which the AFCC insures safe integration of all air defense weapons is through the establishment of air defense rules and procedures. These rules and procedures allow for centralized control of weapons and decentralized execution of the air battle. One of the underlying purposes of these control methods, however, is to limit the fratricide problem. All of the control rules and procedures limit the use of air defense weapons in some way. Yet, because the weapons use the same airspace and the problem of identification of friendly aircraft is not solved at this point in time, strict engagement rules and procedures are required.

The methods of control and integration can be placed into three broad categories that may be referred to as positive means, procedural means, and airspace/geographical means. Included in these broad categories are the rules of engagements and air defense directives that delineate the circumstances by which a weapon may fire at an aircraft.

Positive Means

The engagement decision or target assignment for interceptor aircraft and Hawk units is normally retained in the CRC/CRP. Weapons

control remains highly centralized within the CRC/CRP, and individual target assignments by weapon are normal procedure. According to FM 44-90, however, the engagement decision may be decentralized to Hawk units under special circumstances. The manual states:

> The inability of higher echelons to detect aircraft attacking at low altitudes will, in itself, normally be cause for the delegation of authority for engagement of these targets to Hawk battalion, battery, and/or platoon level during wartime.[32]

This presupposed delegation of engagement authority is not considered a normal mode of operation, yet it serves to illustrate the Army's reluctance to accept centralized control of its resources.

Procedural Means

Procedural means for controlling weapon fires is accomplished by using strict "hostile identification criteria." The rules of engagement contained in the OPlan/OpOrd will include the criteria by which hostile aircraft are identified. These criteria apply to all air defense units. Hostile targets may be identified by either electronic or visual means. In the case of low-to-medium-altitude air defense (LOMAD) weapons (Hawk/interceptor), identification normally is by electronic means. This includes basing hostile declaration on identification, friend or foe (radar) (IFF) response; target speed, heading, and location as determined by radar; and/or ECM emissions. Even these weapons, however, are restricted from firing unless visual confirmation is received. SHORAD

---

[32]DA, FM 44-90, p. 5-10.

hostile criteria are normally visual, for example, "aircraft attacking friendly troops or a defended asset" and "aircraft having the markings and/or configuration of an aircraft belonging to an enemy force."[33]

As SHORAD weapons are the most decentralized of all the air defense weapons in the system, their engagements are even further restricted through a procedure called "weapons control status." The weapons control categories are Weapons Free: fire at any aircraft not positively identified friendly, Weapons Tight: fire only at positively identified hostile aircraft according to hostile criteria, and Weapons Hold: do not fire except in self-defense.[34]

Normally, SHORAD units are restricted to weapons tight status. Also, because of the long and relatively insecure lines of control between the CRC and SHORAD units, all SHORAD weapons in an area of operation operate under the same weapons control status.[35] This highly centralized and restrictive procedure is a disturbing and controversial subject to many ADA officers. Due to the requirement for enemy visual identification in a weapons tight status and given the target speeds versus the small engagement envelopes of SHORAD systems, effective utilization of the SHORAD weapons in this restrictive environment is questionable. A more effective system would be to selectively place

---

[33]DA, FM 44-1, p. 6-1. [34]DA, FM 44-1, p. 6-2.

[35]Department of the Air Force, Director of Operational Plans, Ninth Air Force (TAC), "AFFOR/OPP-AIR/EXORD 702" (Shaw Air Force Base, S. C., 12 August 1977), p. C-17-B-1.

SHORAD units in weapons free status based on location, time, and other decentralized control procedures. This problem of integrating the manually operated SHORAD weapons into the highly centralized electronic IAD structure is a continuing concern for the Army.[36]

Another procedural means of weapons control is the usage of "firing commands" as published in the rules of engagement. Higher echelons use these firing commands to further control weapons engagements when they are decentralized. Typical firing command orders are Hold Fire: destroy missile in-flight, cease tracking, do not fire; Cease Fire: allow launched missile to impact, do not fire but continue to track; and Cease Engagement: allow missile to impact, cease tracking, engage new target.[37]

Airspace/Geographical Means

The major integration method that prevents ground weapons from shooting down friendly aircraft is the employment of airspace and geographical control zones. The airspace restriction problems (see pages 65-70) were raised in discussing the doctrinal issues concerning the "weapons engagement zones." Similar altitude and zonal restrictions to friendly fighter operations exist in the formation of safe passage corridors, restricted and hostile fire areas.

---

[36]Alex Dumbrique, "The Need for Adequate Division Air Defense Command and Control," Air Defense Magazine, October-December 1976, pp. 18-21.

[37]DA, FM 44-90, p. 5-12.

Safe passage corridors exist for friendly aircraft returning from enemy territory. These corridors are based on arrival time, altitude, and heading.[38] These criteria are difficult to coordinate in a large scale exercise, and positive radar control is most often required. Thus, returning aircraft are forced to fly at higher altitudes than tactically necessary so they can be identified as friendly.

FM 44-90 (Hawk employment) lists examples of safe passage corridors as 8,000 to 10,000 feet and 16,000 to 18,600 feet, with aircraft speed at 350 knots.[39] These examples of altitude and airspeed restrictions for fighter operations are grossly unrealistic. Aircraft survival while crossing the FEBA requires that pilots be allowed to operate as low and as fast as possible. Procedures calling for aircraft climbs for identification purposes when approaching the FEBA are unrealistic and are often intentionally violated by interdiction pilots.[40] Restricted and hostile fire areas impose similar operational restrictions on friendly aircraft while denying vast geographical areas to interceptors. This is done to allow "Hawk and other ADA units maximum freedom of action in an area where the enemy has air superiority."[41]

---

[38] DA, FM 44-90, p. 5-14. [39] DA, FM 44-90, p. 5-14.

[40] For an excellent discussion of this problem in the European IADS, see: Department of the Air Force/CINCUSAFE/DO&I, Salty Control (U) (June 1976), pp. 1-82.

[41] DA, FM 44-90, p. 5-15.

Conclusions

The United States IAD employment concept is similar to the concept Egypt used in the 1973 war and the Soviets' "zonal" control. Under current IADS doctrine, weapons engagement zones separate aircraft and ground air defense systems. Simultaneous weapons engagements rarely occur.

Even though the Air Force is given overall responsibility for IAD doctrinal development, the Army ADA doctrine manuals are more current and contain the most complete explanation of the IAD structure and procedures. Air Force doctrine manuals, although recently updated, do not address IAD doctrine vis-à-vis changing balances of power, U.S. Army defensive doctrine, or short and intense warfare. Although the new Army ADA manuals are far superior to the Air Force manuals, some outdated concepts do exist in Army IAD doctrine concerning employment of interceptors and passage of friendly interdiction aircraft.

Organization of the IADS is based on the doctrine of centralized control and decentralized execution and is extremely complex and occasionally dysfunctional. The doctrinal concept of "decentralized authority" for engagement is a misnomer. The entire IADS organization is highly centralized, with uniform rules of engagement, standard operating procedures, and CRC engagement control. Many of the important IAD planning positions are unmanned except in wartime. This makes realistic training, conceptual experimentation, and employment evaluation difficult to impossible.

Methods of control and integration of the IADS are designed to allow the AFCC and the CRC to maintain operational control of all air defense weapons. These control methods are simultaneously restrictive to both Air Force and Army air defense weapons. Weapons engagement zones, "Hawk Belts," and safe passage corridors are currently used to solve the fratricide problem. These control methods require a very sophisticated centralized organization to maintain command of the defensive battle.

This air defense system and its integration process are extremely complex. It is difficult to comprehend how it operates at best in peacetime. Given wartime problems of equipment outages, enemy jamming, and battlefield confusion, the credibility of the IADS is questionable.

CHAPTER V

IADS: EQUIPMENT, WEAPONS, AND TRAINING

> If we are going to train like we're going to fight, and we are, this means working closely with the Army.[1]
>
> General Robert J. Dixon, Commander
> Tactical Air Command, USAF

Introduction

The doctrine, organization, and methods of control and integration for the integrated air defense system (IADS) were presented in Chapter IV to demonstrate its conceptual operation. Equipment, weapons, and training procedures for the IADS are examined in this chapter to determine whether present capabilities match conceptual design. One of the primary concepts for integration of air defense weapons was found to be the principle of centralized command and control. One reason for centralization is the inherent limitation of air defense weapon operators to separate friendly and enemy targets. The centralized control agencies have been given this responsibility, and the design of IADS equipment and weapons reflects this centralization principle.

Current equipment and weapons used in this integration process are presented in this chapter. Only the major components are discussed

---

[1] "Dual Challenges Confront TAC," Aviation Week & Space Technology, 6 February 1978, p. 50.

even though many ancillary support items are necessary to complement the major components. The discussion of the IADS equipment concentrates on the command and control items needed for the management of the centralized integration network. Then, the entire list of IADS weapons is briefly explained to give the reader an appreciation for their capabilities and limitations. This review of the IADS hardware demonstrates the difficulties in effecting operational integration.

As the current United States IADS has never been employed in combat, assessment of its integration effectiveness can be measured only by current joint training exercises. Unfortunately, the entire IADS as envisioned by the doctrine manuals is rarely employed, even in joint exercises. Joint exercises, however, do provide insights into the problems of integration and IADS training. Some inherent integration deficiencies noted in previous chapters are reflected in the training problems discussed in the final section of this chapter.

Command and Control Equipment

The IADS equipment list is extensive. Included in the list are numerous support facilities, vehicles, and communication equipment. For brevity and simplification, however, the discussion concerns only the major items required for integration purposes. Order of presentation parallels the organizational lines of control from the top down (see Fig. 11, page 74). Major command and control facilities such as the tactical air control center (TACC), control and reporting center/control and reporting post (CRC/CRP), Hawk Army Air Defense Command Post (AADCP),

etc., are shown, with emphasis on integration capabilities and limitations.

Tactical Air Control Center

The first major IADS command and control item is the TACC Operations Central AN/TSQ-92 (see Figs. 13, 14, and 15). This unit provides the Air Force Component Commander a facility for control of the entire air effort. The major limitation of the AN/TSQ-92 is that all management information must be manually processed on plotting boards within the unit. A recent article explained that "with the existing system, the time required to update and display the air situation can require 10 min. or longer."[2] This is one reason the air defense battle is delegated to the CRC. Another limitation is that the AN/TSQ-92 is relatively insecure to enemy air attack when it is deployed, and consequently it must be placed well to the rear for self-protection. The system is portable and modular in design, which allows it to support an operation that has 3 to 24 tactical fighter squadrons.[3]

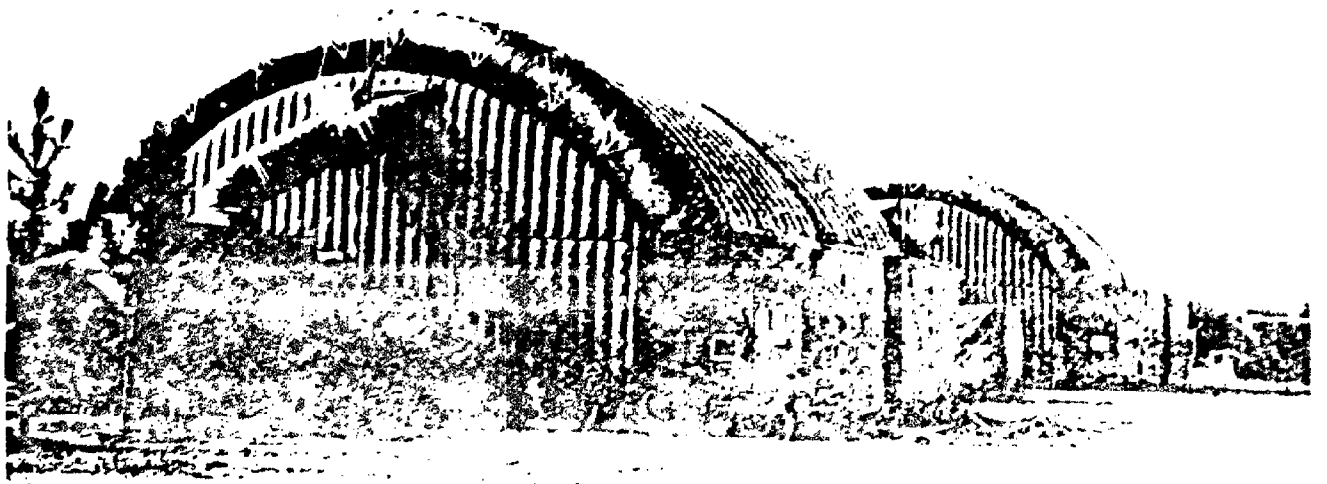
Control and Reporting Center/
Control and Reporting Post

The next major piece of equipment in the IADS organization is the CRC/CRP Operation Centers AN/TSQ-91 (see Figs. 16 and 17). Like the

---

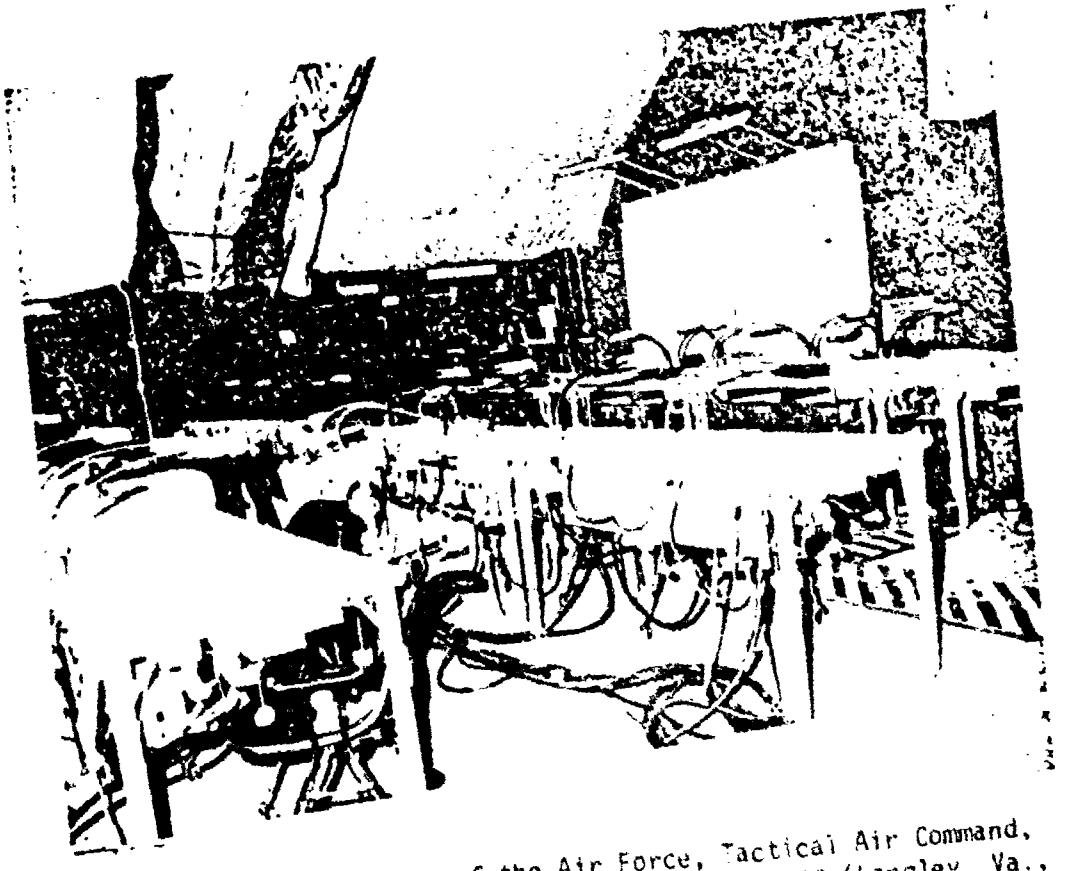
[2]"Battle Assessment Techniques Pressed," Aviation Week & Space Technology, 6 February 1978, p. 243.

[3]Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), pp. 4-43 through 4-49 (hereinafter cited as DAF, TAC, TACP 55-43).



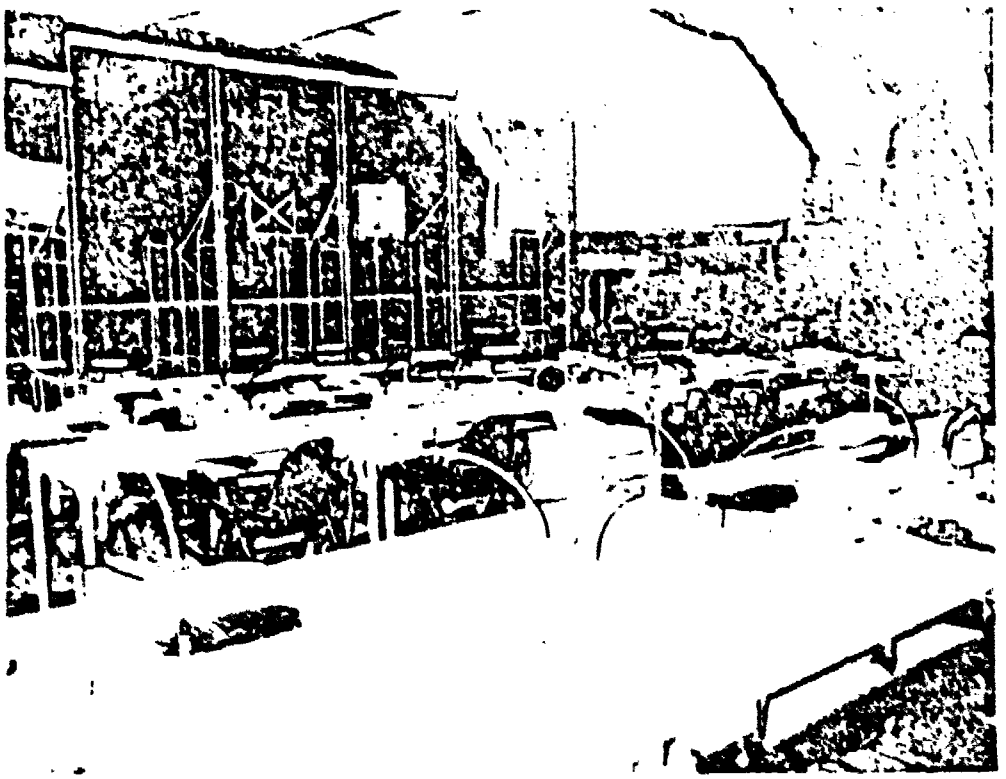
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-47.

Fig. 13. TACC Operations Central AN/TSQ-92



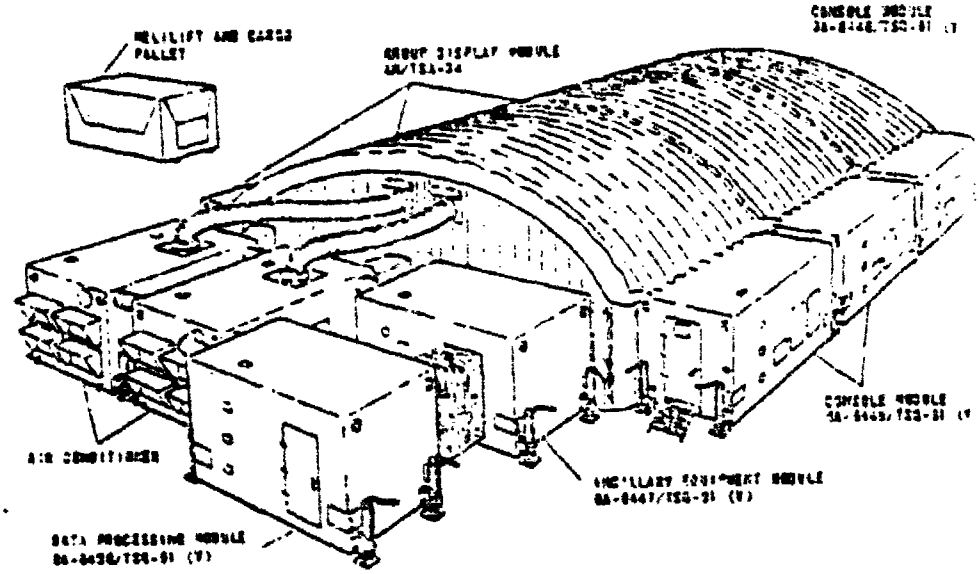
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-48.

Fig. 14. Interior View of AN/TSQ-92



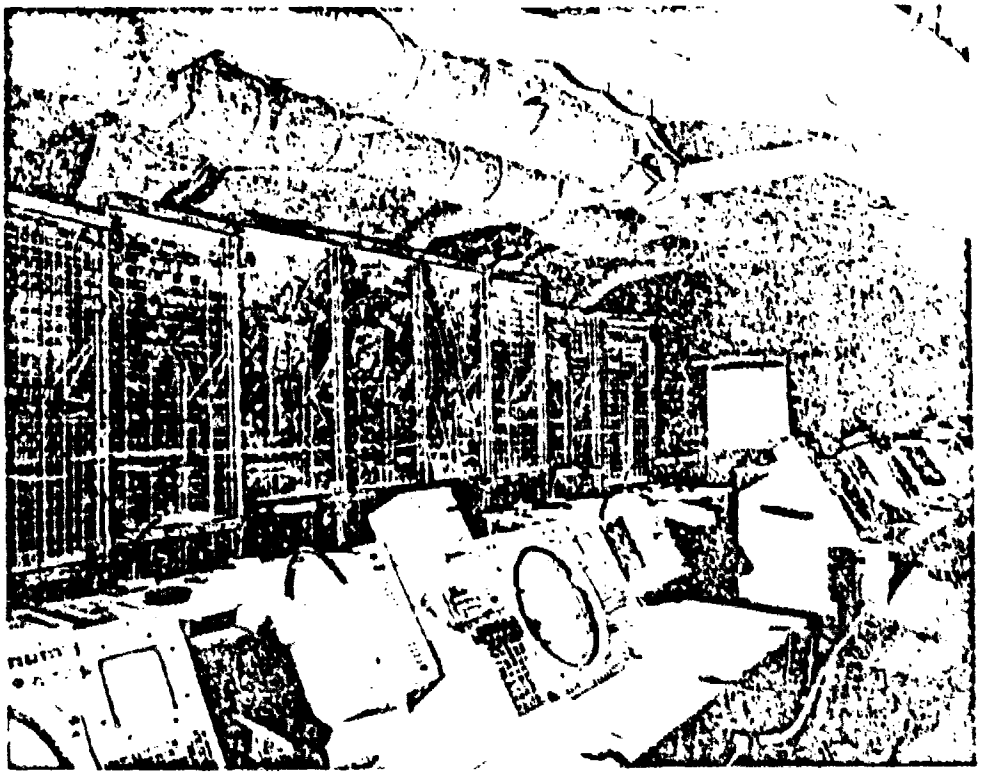
SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-49.

Fig. 15. Interior View of AN/TSQ-92



SOURCE: Department of the Air Force, Tactical Air Control System (TACS): Surveillance and Control of Tactical Air Operations, TACR 55-44 (20 March 1975), p. 48.

Fig. 16. CRC/CRP Operations Central AN/TSQ-91 (V)



SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-35.

Fig. 17. Interior View of AN/TSQ-91

TACC, the AN/TSQ-91 is mobile and modular in design for variable deployment configurations. Its major feature is a data processing module that contains the HM-4118 Computer. With this module, the CRC has the capability to operate both manually and in computer-assisted operations. In the computer-assisted mode, the HM-4118 "processes surveillance, computes weapons data and generates console displays."[4] Like the TACC, the CRC presents a rather large static target to enemy action. For this reason, CRCs are deployed in rear areas and are linked to a network of forward air control posts (FACPs) that function as low altitude radar gap fillers. The FACPs consist of an AN/TSQ-61 Operations Central, which is a two-scoped van connected to either a TPS-44 or a TPS-43 radar (see Fig. 18). The FACPs are far more mobile than the CRCs/CRPs. Communication between the FACP, CRP, and CRC is provided through two-way voice, digital data, and teletype nets.[5]

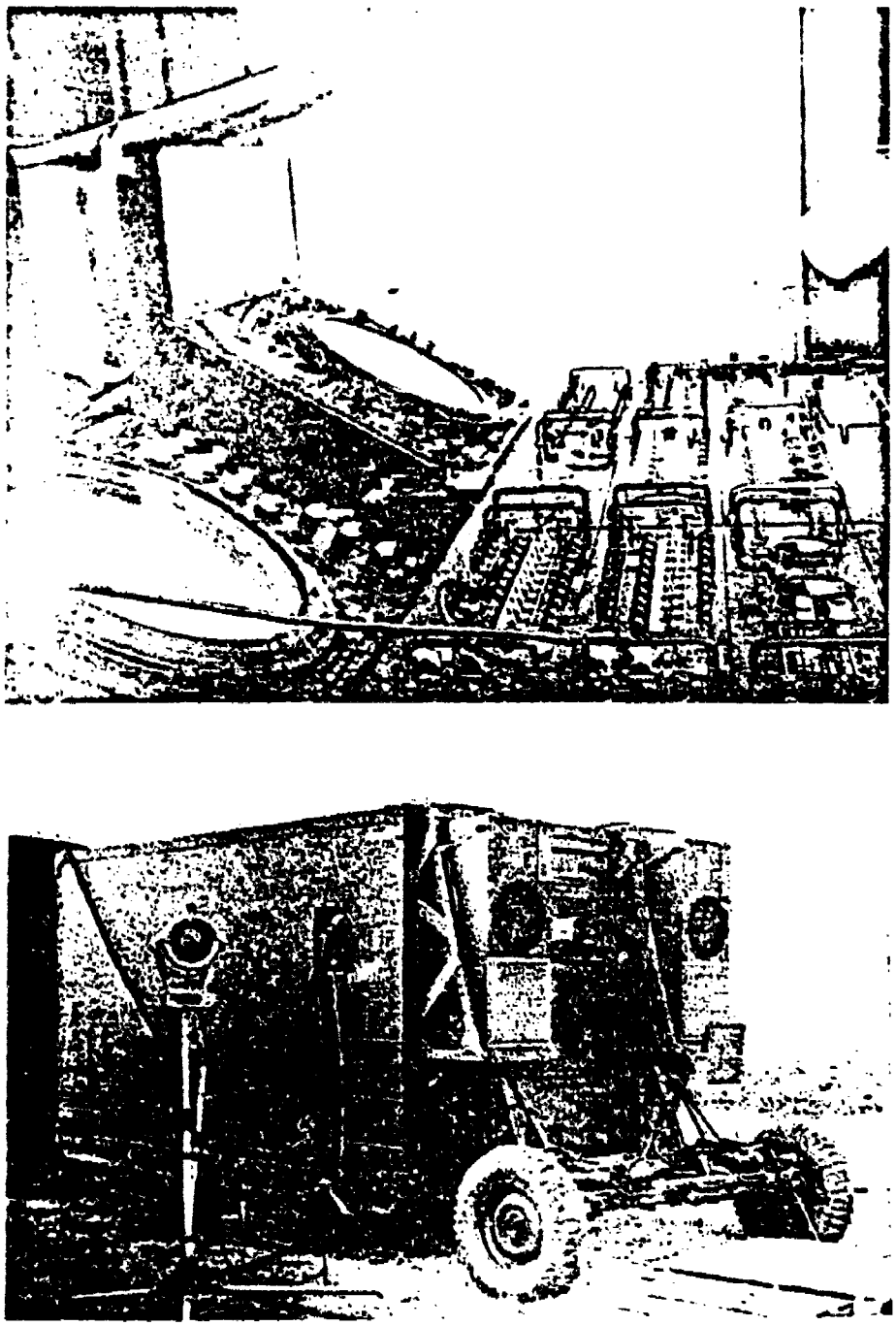
Air Force Early Warning Ground Radar

The primary radar currently employed by the Tactical Air Control System (TACS) is the AN/TPS-43 E Radar Set (see Fig. 19). It is a mobile ground radar designed for simultaneous long range search and height finding. It has the capability to interface with the CRC, the CRP, and the FACP operation centers. Its range capability is listed as

---

[4]DAF, TAC, TACP 55-43, p. 4-30.

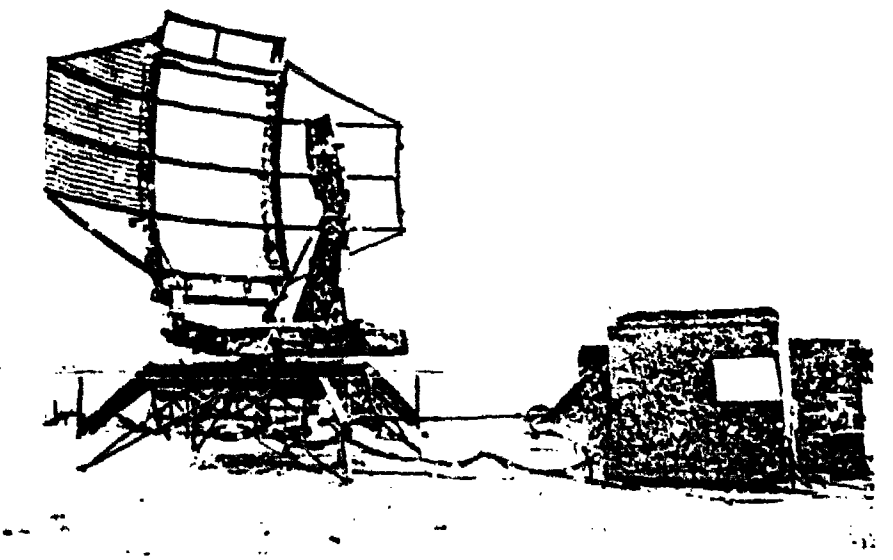
[5]DAF, TAC, TACP 55-43, pp. 4-26 through 4-28.



SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), pp. 4-26 & 4-28.

Fig. 18. FACP Operations Central AN/TSQ-61

200 nautical miles with a height finding capacity of 75,000 feet. Minimum altitude coverage is classified, but, due to ground clutter and line of sight limitations, the effective low altitude (below 1,000 feet) is limited.[6] A recent modification includes a moving target indicator function on the radar that reduces most of the ground clutter problem.[7]



SOURCE: Department of the Air Force, Tactical Air Command, Tactical Air Control System Equipment, TACP 55-43 (Langley, Va., 28 September 1973), p. 4-3.

Fig. 19. AN/TPS-43E Radar Set

---

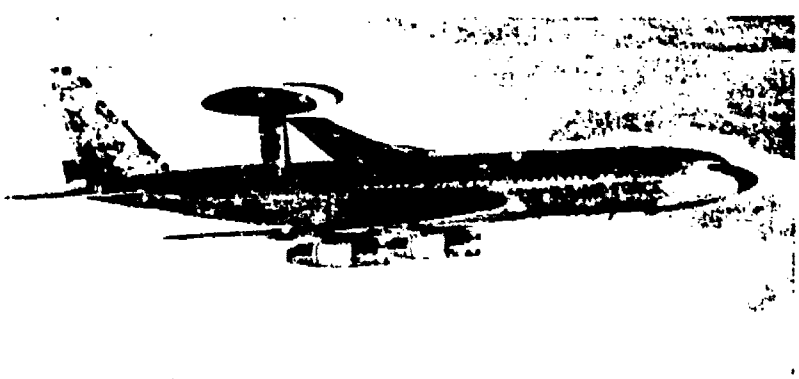
[6]DAF, TAC, TACP 55-43, p. 4-3.

[7]Department of the Air Force, 727th Tactical Control Squadron (TAC), "After Action Report of Detachment 1, 727 Tactical Control Sq for Red Flag 78 1-2 (U)," Prepared by James E. S. Burns (Bergstrom Air Force Base, Tex., 10 January 1978), p. B-1 (hereinafter cited as DAF, 727th Tac Con Sq (TAC)).

Airborne Warning and Control System

The airborne warning and control system (AWACS) (see Fig. 20) program is now in the initial training phase prior to operational deployment. The AWACS offers the IADS a capability for low altitude target detection never before possible.

> . . . As an air defense system, it will detect, identify and track low-flying enemy aircraft and guide friendly interceptors against the intruders. From an altitude of 30,000 ft, the E-3A [AWACS] can detect low flying aircraft out to the radar horizon at a range of 245 mi.[8]



SOURCE: "A Major Command Tactical Air Command," Air Force Magazine, May 1977, p. 82.

Fig. 20. E-3A Airborne Warning and Control System

As the AWACS has not yet been operationally deployed, how it will integrate into the IADS picture remains to be demonstrated. Whether the AWACS will operate as simply a long-range radar platform or will replace the CRCs in air battle management has not been definitely

---

[8]Benjamin M. Elson, "TAC Readies for Deployment of E-3A," Aviation Week & Space Technology, 6 February 1978, p. 106.

determined. Certainly the AWACS has capabilities far beyond the radar early warning role normally associated with its mission. These employment issues, together with various software and hardware modifications, are yet to be resolved.

Army Air Defense Command Post

The next facility in the organizational chain of control is the Army Air Defense Command Post. This is the headquarters to which the Air Defense Artillery Liaison Officer (ADALO) must communicate to integrate Army/Air Force weapons. In the past, all coordination between the CRC and the AADCP was via voice communication and manual plotting. This was time-consuming and ineffective. With the recent operational deployment of the AN/TSQ-73 Missile Minder (see Fig. 21), the Army now has the capability for complete two-way automatic data link between the CRC and the AADCP. This capability allows the Army to pass near-real-time early warning information to the CRC from Hawk radars and also to receive Air Force target information from the TPS-43s or AWACS. With or without the AN/TSQ-73, the configuration of the AADCP must remain mobile and flexible to meet requirements of the air defense situation. Any suitable shelter (building, tent, or vehicle) may be used (see Fig. 22).[9]

---

[9]Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), pp. B-2 & B-3 (hereinafter cited as DA, FM 44-90); and Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), pp. 5-3 & 5-4 (hereinafter cited as DA, USAADS).

Fig. 21. Missile Minder (AN/TSQ-73)

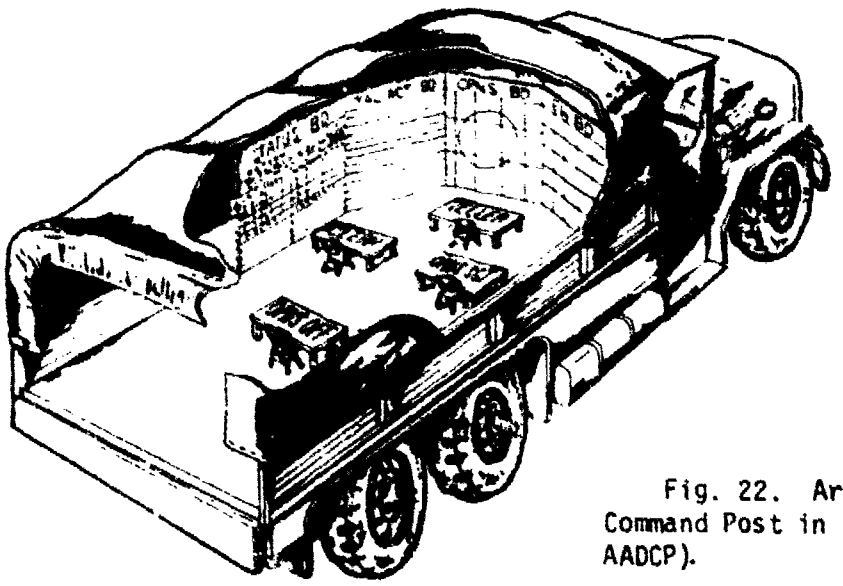


Fig. 22. Army Air Defense Command Post in Truck (Manual AADCP).

SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 5-3 (Fig. 21) & p. 16-16 (Fig. 22).

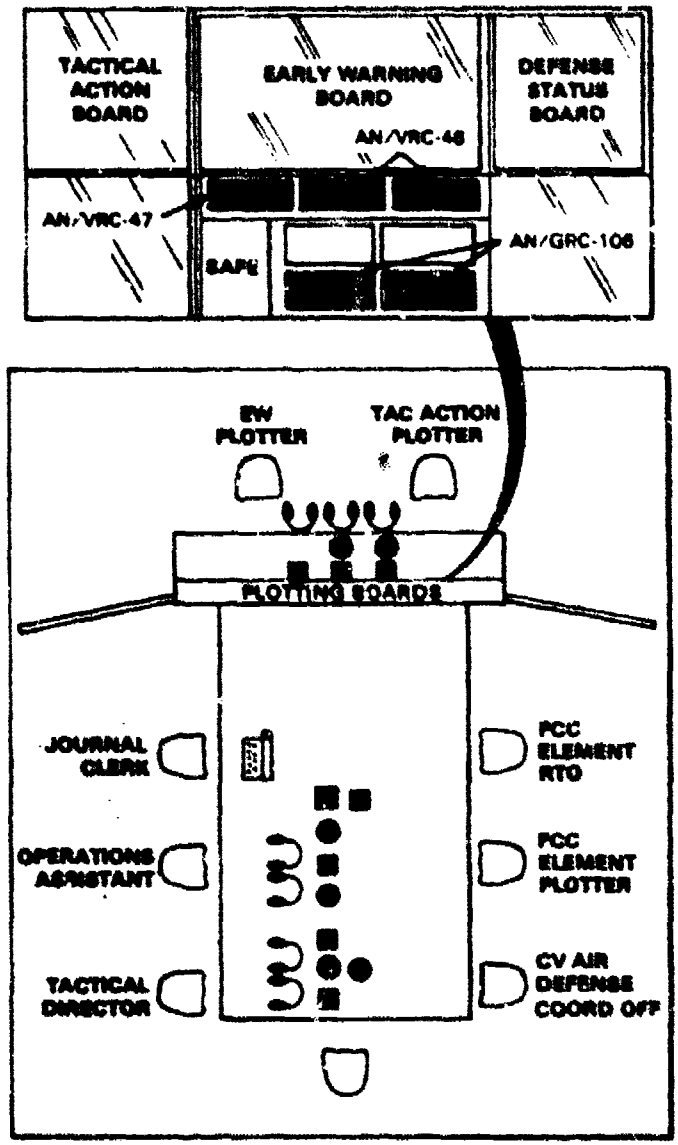
Army Hawk Equipment

For Hawk employment, the CRC/ADALO passes target assignments through the AADCP to the Hawk air defense battalion operations center (BOC). The BOC normally consists of three basic components: the AN/TSQ-73, a backup manual fire control element, and an operations and intelligence element. The fire control element, located in an expandable van, is responsible for the conduct of the air battle for the Hawk battalion (see Fig. 23).[10] As seen in Figure 23 and as described in Chapter IV (page 80), the Chaparral/Vulcan (C/V) Air Defense coordination officer (ADCO) is located in this van. His main purpose is to keep the C/V AADCP advised of the current weapons status and procedural changes, but he can also pass target information to the C/V AADCP from early warning and tactical action boards in the BOC (see Fig. 24). This target information, however, is plotted manually in World Geographic Reference System (GEOREF) grid coordinates that must be converted to universal transverse mercator grid coordinates, the coordinates short-range air defense (SHORAD) units use. By the time high speed tracks could be passed from these boards to the C/V AADCP and received by the C/V fire units, the information would probably be too dated to be useful.

Another limitation of the BOC for effective integration between Army and Air Force components is the lack of UHF capability in the BOC.

---

[10] DA, FM 44-90, pp. B-1 through B-11.

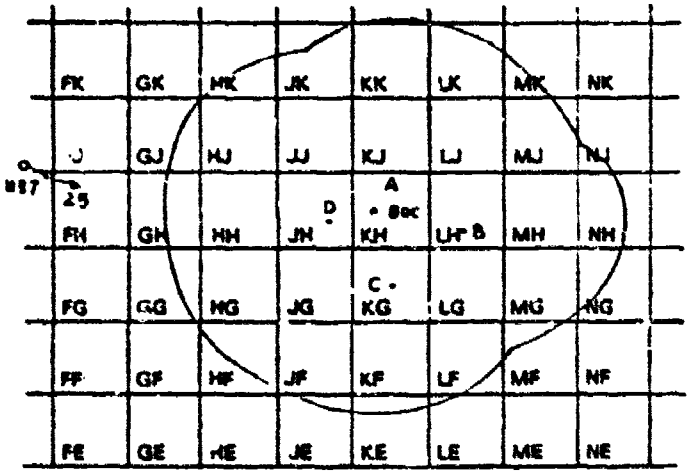


SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. B-4.

Fig. 23. Hawk Battalion Operations Center

DEFCON	3	POP-UP		ECM				
AOA WARNING		METHOD OF CONTROL					WAO	
RED	X	BATTALION					F	
YELLOW								
WHITE								
STATUS OF UNITS								
UNIT	SITE	ALERT STATUS					REMARKS	MSL CT
		60	5 Min	20 Min	30 Min	1 HOUR	0+0	
A (-)	21	X						9
A (DFP)	21A					X		9
B (-)	22	X						16
B (DFP)	22A	X						12
C (-)	23	X						10
C (DFP)	23A	X						14
D (-)	24					X		10
D (DFP)	24A	X						16

DEFENSE STATUS BOARD



EARLY WARNING BOARD

TRK #	A/C	ALT	SPD	SITE	ACQ	L/O	MA	RESULTS	REMARKS
M01	3	60	50	23	18	20	23	KILL	
M36	1	5	40	22A	19	22	24		
M37	2	50	40	21	25	27	29		

TACTICAL ACTION BOARD

SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 8-5.

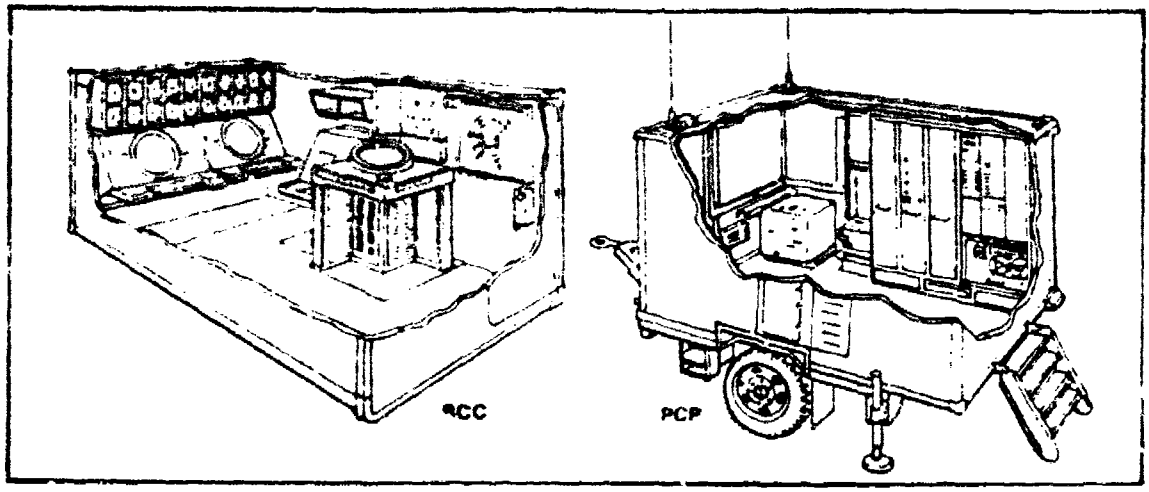
Fig. 24. Battalion Operations Center Early Warning and Tactical Boards.

The AN/VRC-46/47 and the AN/GRC-106 give the Hawk units only AM/VHF/FM and high frequency single side band (HFSSB) capabilities. The CRC, on the other hand, conducts all ground-to-air coordination with interceptors using UHF communication. Without UHF capability in the Hawk system, there can be no interchange of information between interceptors and surface-to-air units without going first through the CRC. This fact alone makes autonomous operations (operations without CRC control) by either Hawk or interceptors extremely difficult. In contrast, when simulating Soviet IADS in Red Flag exercises and Tactical Fighter Weapons Center tests, Red Force interceptors flying autonomous combat air patrols would oftentimes "listen in" on simulated surface to air missile (SAM) UHF early warning nets and exchange target information. This tactic proved extremely successful for both interceptor pilots and SAM operators.[11] These types of integration, however, cannot be practiced in United States IADS employment, because the UHF equipment is not operationally available to Hawk and SHORAD units.

This lack of interceptor/Hawk integration capability is unfortunate, for Hawk units possess significant organic target early warning and acquisition equipment. The information received from this equipment is first displayed in the Hawk battery control central (BCC) or in the platoon command post (PCP) (see Fig. 25). The BCC is the location for

---

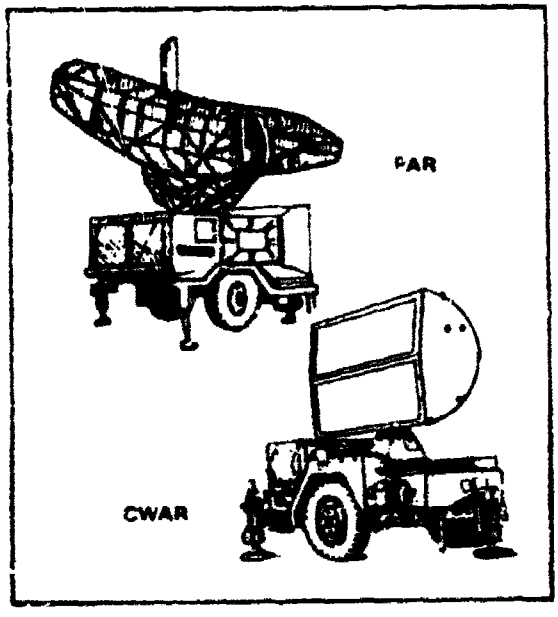
[11]Personal experience by this writer, who participated in Red Flag exercises and Tactical Fighter Weapons Center tests during the period 1973-1977.



SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 4-2.

Fig. 25. Battery Control Central (BCC) and Platoon Command Post (PCP).

the Tactical Control Officer, a lieutenant who executes the fire order. A pulse acquisition radar (PAR) and a continuous wave acquisition radar (CWAR) (see Fig. 26) feed early warning target information to the BCC.



SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Hawk, FM 44-90 (30 November 1977), p. 4-3.

Fig. 26. Hawk Radars

The PAR can detect targets at low and medium altitudes in excess of 100 kilometers. The CWAR, using doppler principles, can detect very low targets in excess of 60 kilometers. For target tracking, a separate high power illuminator radar (HIPIR) is used. The HIPIR also operates on doppler principles and can track targets in excess of 100 kilometers. The ranges mentioned are approximations and do not account for line of sight and electronic countermeasures limitations. Due to terrain features, low-altitude enemy detection ranges could be reduced to approximately 23 kilometers.

Target information received by organic Hawk radars is displayed on radar scopes in the BCC or the PCP. It is then data-linked to the Hawk BOC. Without the TSQ-73 equipment, target information would terminate at the BOC and would then have to be manually relayed through an AADCP to the CRC for plotting and updating. With the deployment of the TSQ-73, this information is automatically relayed into the CRC.[12]

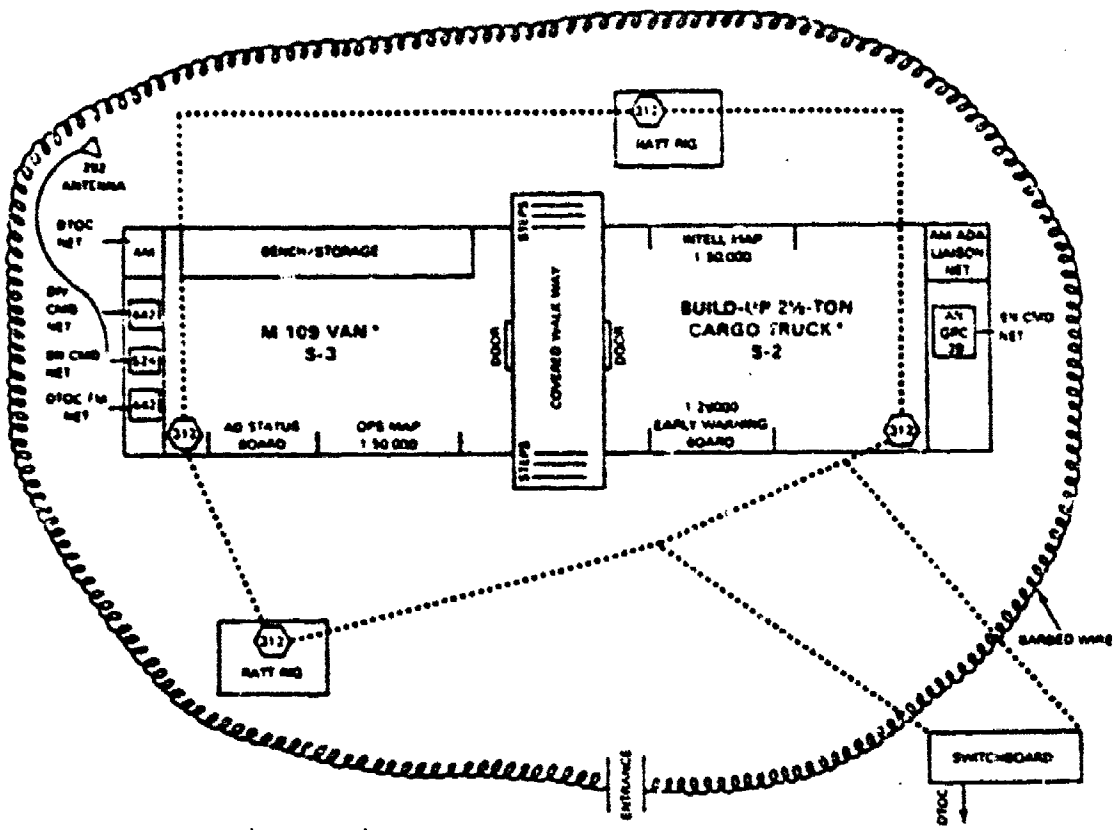
Short-Range Air Defense Control Equipment

The C/V units are controlled from the tactical operations center (TOC), which is collocated with the C/V battalion command post. There is no standard layout for the TOC; its layout depends upon unit needs and the commander's desires. Figure 27 shows a typical TOC layout. The C/V squads and Redeye section leaders are required to maintain

---

[12]DA, FM 44-90, pp. 4-2 through 4-9.

communication links with the TOC to obtain changes in air defense rules, procedures, weapons control status, and early warning information.[13]



SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3 (30 September 1977), P. I-2.

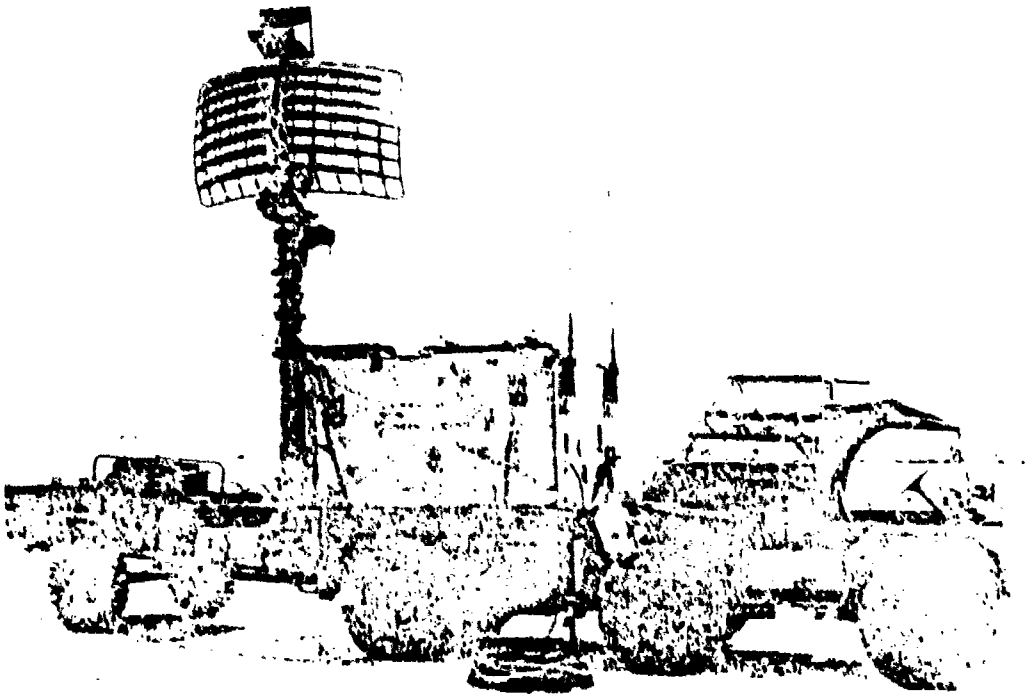
Fig. 27. Chaparral/Vulcan Battalion Tactical Operations Center

Unfortunately, the C/V TOC and SHORAD units do not have the capability to receive long range early warning information from Hawk or Air Force radars. The SHORAD units are solely dependent on visual means

---

[13]Department of the Army, U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3 (30 September 1977), pp. I-1 through I-5 (hereinafter cited as DA, FM 44-3).

or the forward area alerting radar (FAAR) system AN/MPQ-49 (see Fig. 28).

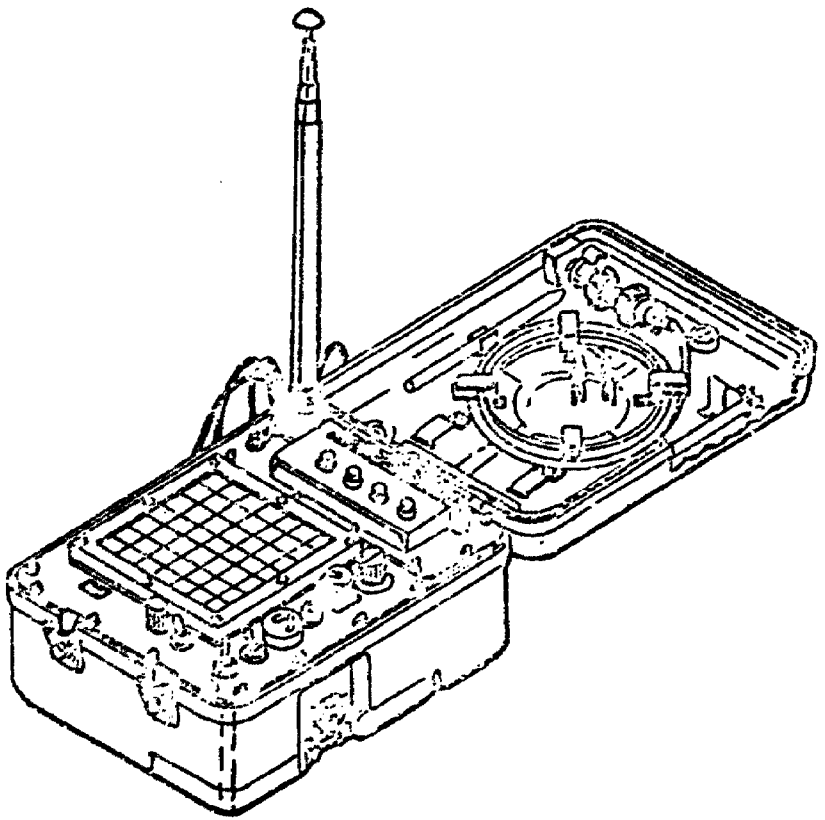


SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 6-3.

Fig. 28. Forward Area Alerting Radar

The FAAR is a lightweight, short range, mobile radar set that is capable of detecting targets out to 20 kilometers. The FAAR displays target information on a grid system on the target alert data display set (TADDS) that is carried by each C/V squad and each Redeye team (see Fig. 29). Target information is relayed to the TADDS via FM radio frequency data link.[14] This target information cannot be passed back up

[14] DA, USAADS, pp. 6-3 & 6-4.



Equipment

Field Emplacement

SOURCE: Department of the Army, U.S. Army Air Defense School. Air Defense Artillery Reference Handbook (1977), pp. 6-3 & 6-5.

Fig. 20. Target Alert Data Display Set (Equipment and Field Emplacement)

the chain of control (i.e., Hawk or Air Force) for integration into the air defense system. Thus the SHORAD units are basically "on their own" as far as early warning and target information are concerned.

Weapons

Air defense weapons form the final link in the integrated system. Both the Air Force and the Army are in the midst of a modernization program. Vast improvements in air defense capabilities are being incorporated into the IADS, with weapon systems such as the F-15, F-16, Patriot, Roland, and Stinger. It must be remembered, however, that the optimistic capabilities of these weapons are limited to a large extent by the organizational control placed on their employment due to the integration problems discussed earlier. These new systems and current IADS weapons (the F-4E, Nike-Hercules, I-Hawk, Chaparral, Vulcan, and Redeye) must be effectively integrated with existing doctrine.

F-15 Eagle

The F-15 Eagle (see Fig. 30) is becoming the primary Air Force contribution to the IADS weapons family. As a single mission air superiority fighter, its most important improvement over older aircraft is

SOURCE: S. H. H. Young, "Gallery of USAF Weapons," Air Force Magazine, p. 118.

Fig. 30. F-15 Eagle

its ability to detect high-speed, low-altitude targets with its pulse-doppler radar. Four radar-guided, long-range (28 miles) AIM-7F Sparrow missiles (see Fig. 31) are carried externally on the F-15. In addition, four short-range (two miles), maneuverable, infrared-guided AIM-9J/L Sidewinder missiles (see Fig. 32) are also carried. The F-15 also has an internally mounted 20mm Gatling gun for close-in aerial combat.[15]

The major limitations to the F-15 are its high unit cost and the small numbers being purchased (729). Despite its advance notices as a technical panacea for future aerial combat, a recent joint test to evaluate air combat verified the fact "that superior numbers generally are an advantage in a free-wheeling aerial engagement."[16] In this test the F-15 only generated an average kill ratio of 2:1 over a less sophisticated Soviet threat presumed for the 1980s. Thus, while the F-15 is a major improvement in air superiority capability, additional forces will be required to counter numerically superior forces.

F-4E Phantom II

The F-4E Phantom II (see Fig. 33) remains the workhorse of the U.S. Air Force's tactical inventory. As the "swing-force" (multirole) aircraft of tactical air forces, it is capable of performing air superiority, close air support, and interdiction missions. Although the F-4

---

[15]S. H. H. Young, "Gallery of USAF Weapons," Air Force Magazine, May 1977, pp. 118 & 127-28.

[16]Donald E. Fink, "Flight Tests Confirm New Missiles Need," Aviation Week & Space Technology, 6 February 1978, p. 89.

Fig. 31. AIM-7F Sparrow

Fig. 32. AIM-9J Sidewinder

Fig. 33. F-4E Phantom II

SOURCE: S. H. H. Young, "Gallery of USAF Weapons," Air Force Magazine, p. 127 (Fig. 31), p. 128 (Fig. 32), & p. 117 (Fig. 33).

does not possess the radar and performance capability of the F-15, due to the numbers deployed and weapons carriage (4 Sparrows, 4 Sidewinders, and a 20mm gun), the F-4E represents a potent weapon in the IADS arsenal.[17]

F-16

In the near future, the F-16 (see Fig. 34) will replace the F-4 as the swing-force fighter of tactical air forces. Its primary mission will be air-to-ground; however, like the F-4E, the F-16 can perform in a secondary air-to-air role. The major limitation to its replacing the F-4E in the air superiority role is its lack of a long range missile capability. Current production models carry only two Sidewinder missiles with a range of two miles and a 20mm gun. This limits the F-16 to primarily visual short-range engagements.[18]

SOURCE: S. H. H. Young, "Gallery of USAF Weapons," Air Force Magazine, p. 118.

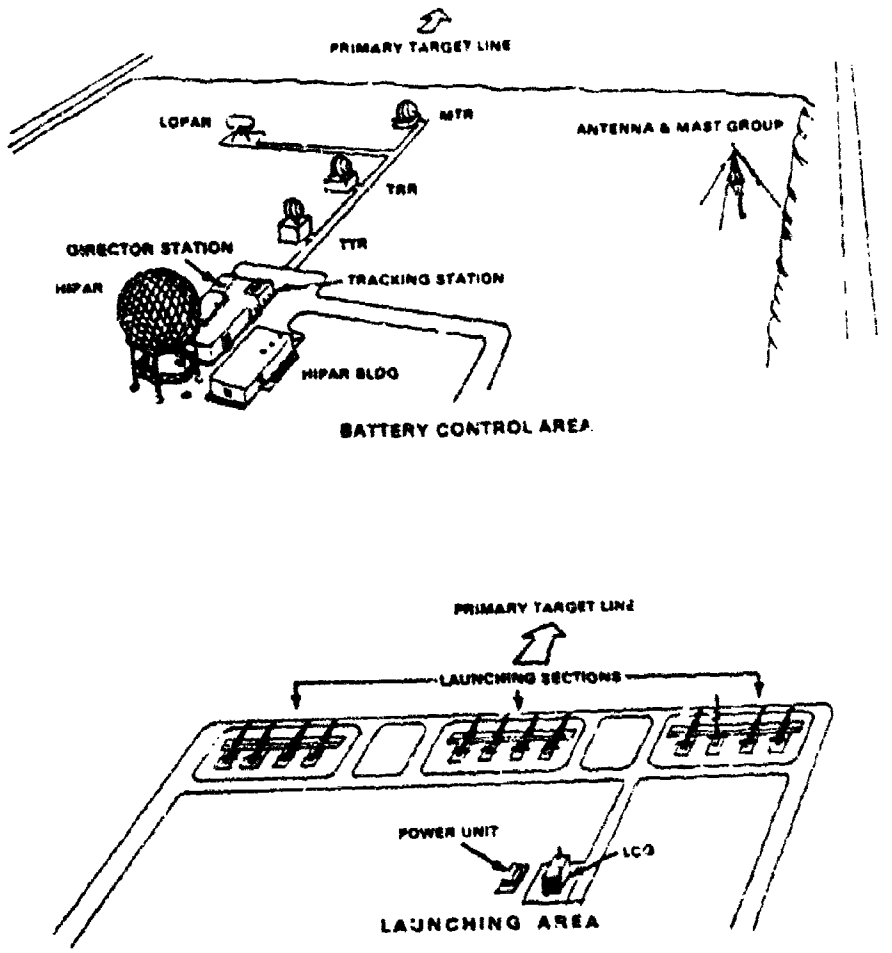
Fig. 34. F-16

Nike-Hercules

The Army's Nike-Hercules system (see Fig. 35) is a long-range, high-altitude radar-guided surface-to-air missile system. It is a semipermanent strategic defense system that is capable of engagement

---

[17]Young, p. 117. [18]Young, p. 118.



SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 3-6.

Fig. 35. Nike-Hercules

ranges from 75 to 100 miles and altitudes of 150,000 feet. It can carry either a conventional or nuclear warhead and can also be employed effectively in a surface-to-surface mission.[19]

Improved Hawk (I-Hawk)

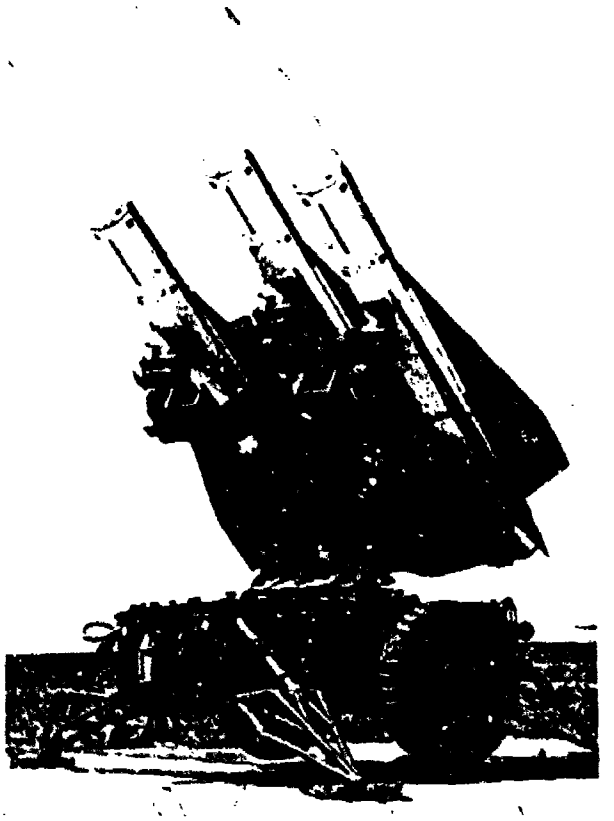
The I-Hawk (see Fig. 36) is the mainstay of the Army's present air defense artillery inventory. It is a medium range, low-to-medium altitude, radar-guided missile system. The altitude capability of the I-Hawk ranges from 100 meters to 40,000 meters. The system is relatively mobile since all of its major components are trailer mounted and air portable. The Hawk system is presently the Army's only operational low-altitude air defense weapon that utilizes radar guidance for all-weather intercept capability.

Chaparral

The Chaparral (see Fig. 37) is a highly mobile surface-to-air missile system designed against the low-altitude threat. Simply stated, the Chaparral is a tracked vehicle with four Sidewinder missile launching stations. It can carry up to 12 missiles. The major limitation to the Chaparral, as with other SHORAD weapons, is that it is strictly a visual detection system. It has no radar for search or track and it must rely on the FAAR system, discussed earlier, for early warning. Target acquisition and identification are accomplished visually, and

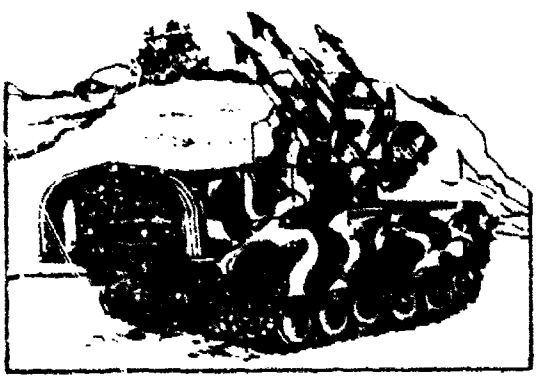
---

[19] DA, USAADS, pp. 3-3 through 3-6.



SOURCE: Wilfred L. Ebel, "Japan's Developing Army," Military Review, April 1978, p. 31.

Fig. 36. I-Hawk



SOURCE: Department of the Army, U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan, FM 44-3 (30 September 1977), p. 4-2.

Fig. 37. Chaparral

infrared heat sources guide the missile. The Chaparral cannot be fired while it is on the move.[20]

Vulcan

The Vulcan (see Fig. 38) is the Army's primary antiaircraft gun system. Simply, it is a self-propelled tracked vehicle with a 20mm Gatling gun mounted on its chassis. The Vulcan, like the Chaparral, does not have a target acquisition radar associated with its gun. All tracking is accomplished manually by using visual acquisition and identification. The Vulcan does possess a range-only radar, but it provides only lead information for the fire control system.[21]

Redeye

The last of the current SHORAD systems, in addition to the Chaparral and Vulcan, is the Redeye (see Fig. 39), a man-portable missile system. The Redeye is a shoulder-fired, heat seeking missile that is designed to counter low-altitude aircraft and helicopters. It has an effective range of about 3 kilometers. The Redeye is primarily a tail-chase type weapon. Like the other SHORAD weapon operators, the Redeye operator must visually acquire and identify the target.[22]

Patriot

As stated previously, the Army, like the Air Force, is in the

---

[20] DA, FM 44-3, p. 4-3. [21] DA, FM 44-3, pp. 4-3 & 4-4.

[22] DA, FM 44-3, pp. 4-5 & 4-6.

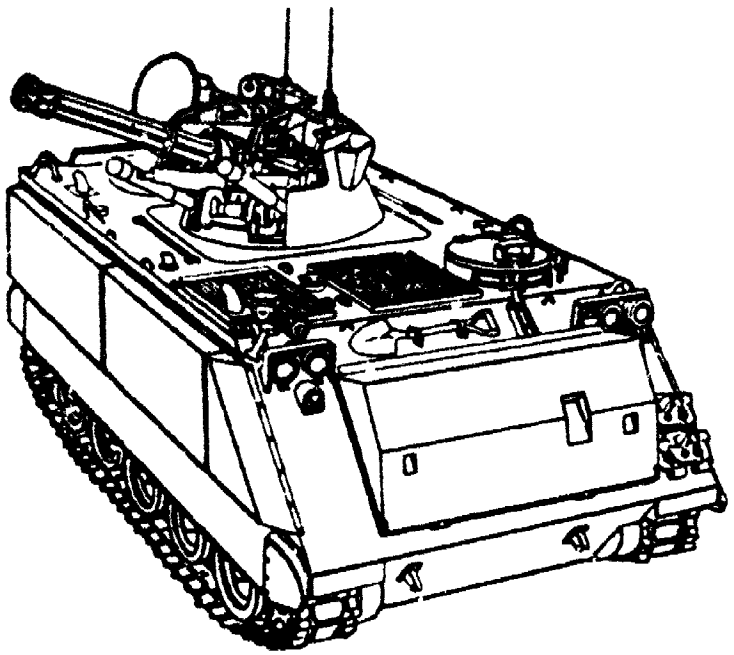


Fig. 38. Vulcan

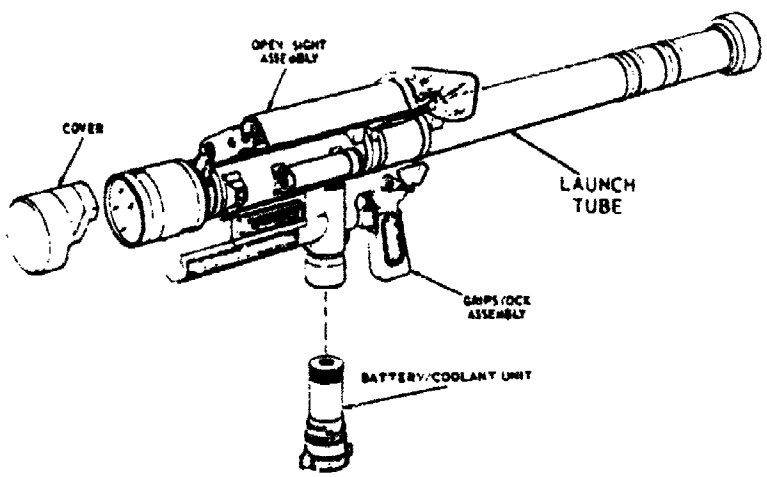
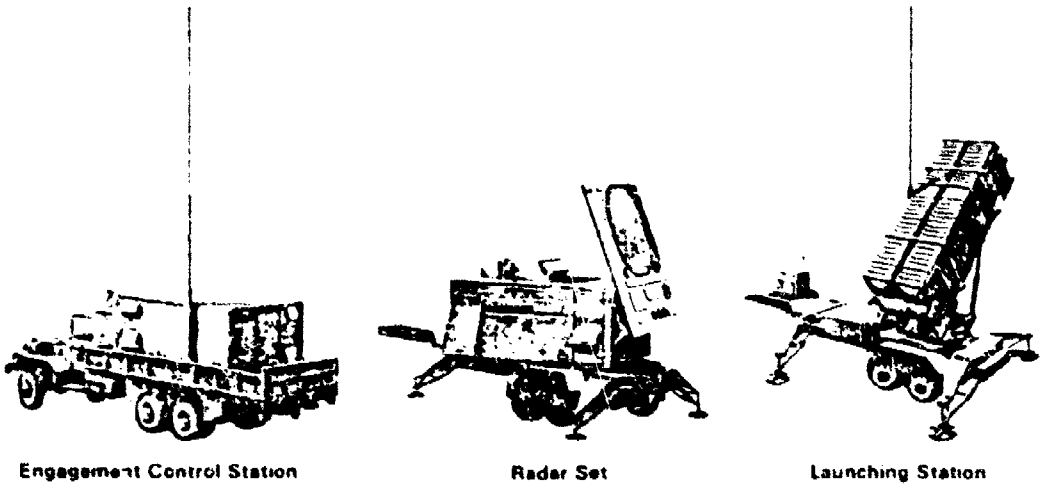


Fig. 39. Redeye

SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 2-2 (Fig. 38) & p. 3-3 (Fig. 39).

midst of a massive modernization effort to replace air defense weapons with newer systems. These weapon systems, called the Patriot, Roland, and Stinger, will become operational in the late 1970s and early 1980s. The Patriot (see Fig. 40) is the foremost of the new systems and is just now completing final developmental testing.



SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 7-4.

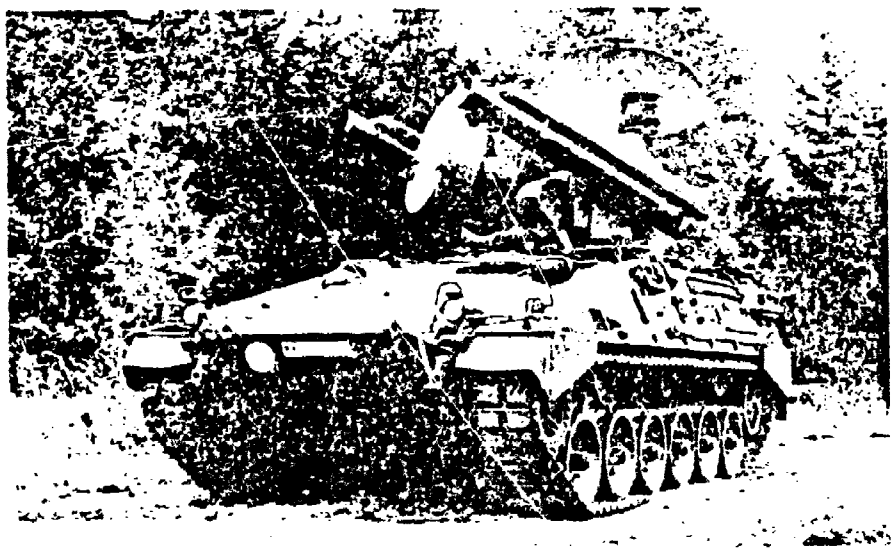
Fig. 40. Patriot Missile System

When operational, the Patriot will be the replacement for the Nike-Hercules and the Hawk systems. Advance notices on the Patriot are impressive. It has a single phased array radar that performs the simultaneous functions of search, detect, identify, and track. The weapon system can simultaneously handle more than 50 targets and a total of 8 missiles, including 3 in the terminal mode. The Army places high hopes for the Patriot as the "cornerstone of the mid-1980 family of air

defense weapons."[23] One disadvantage of the Patriot is that it is less mobile than its self-propelled Soviet counterparts, the SA-4 and SA-6.

Roland II

As a replacement for the Chaparral, the Army has adopted a United States version of the French/German Roland II (see Fig. 41)



SOURCE: "Roland Weapon System Reaches Production Stage," Military Review, March 1978, p. 101.

Fig. 41. Roland II

short-range, all-weather air defense system. The Roland missile can be either radar or optically guided to its target and it has a range of 8 kilometers. The fire unit, mounted on a tracked vehicle, contains a search radar that can identify friend or foe, a tracking radar, an

---

[23] DA USAADS, pp. 7-3 & 7-4.

optical sight, two automatic reloading launchers, and two missile magazines, each of which holds four missiles.[24] With the introduction of the Roland II and its self-contained search/track radars into the inventory, centralized integration of air defense weapons will become even more complex.

Stinger

The Stinger (see Fig. 42) is a man-portable air defense missile

SOURCE: Department of the Army, U.S. Army Air Defense School, Air Defense Artillery Reference Handbook (1977), p. 7-1.

Fig. 42. Stinger

system that is designed to replace the current Redeye weapon. Although the Stinger uses the same infrared homing principle as the Redeye, it has an improved seeker and an advanced guidance unit that gives it an all-aspect capability. The Stinger also has improved range and velocity capabilities and an identification, friend or foe (radar), challenge

---

[24]John Marriott, "Roland II," NATO's Fifteen Nations, April-May 1975, pp. 101-102.

receiver. It is expected that the Stinger will be in the hands of troops by the late 1970s.[25]

Equipment Integration Programs

Currently, several major joint programs are under study to improve the integration of the air defense system. Three projects designed to better integrate the command and control informational flow are Tactical Air Control System/Tactical Air Defense System (TACS/TADS), Joint Tactical Information-Distribution-System (JTIDS), and Automated Tactical Air Control Center (TACC-Auto). These programs are briefly discussed to demonstrate that defense managers are not completely overlooking the air defense integration problem.

The TACS/TADS program was established in 1969 as an ongoing study to insure interservice integration of present and future command, control, and communication systems. The major hurdle for TACS/TADS managers was to integrate the command and control computers of the various services and force them to "talk" to each other. The Air Force computers in the AWACS and 407L Tactical Air Control System use the Tactical Digital Information Link-A (TADIL-A), while the Army's TSQ-73 uses TADIL-B language. The TACS/TADS project developed a message processing center to convert the TADIL computer language for interservice usage.[26]

---

[25] DA, USAADS, pp. 7-1 & 7-2.

[26] Ronald Dean Koblitz, "The Tactical Air Control System, Tacti-

The JTIDS program is another information integration project. It is a new jam-resistant digital data-link system that is designed to pass real-time tactical information between target acquisition, command and control, and weapons systems.[27] The third program that will provide the IADS manager with a more rapid information flow is TACC-Auto. The TACC-Auto is designed to provide the TACC with computer-generated air battle situation displays to replace the manual displays in the present TACCs. Hopefully, this project will cut the long delays in battle situation updating (10 minutes or longer) and will provide instantaneous (real-time) readouts.[28]

Training

Despite the major studies being made in weapons modernization and information integration, some of the most significant problems with increasing IADS effectiveness remain in the training area. Effective IADS employment requires extensive joint service training. As one of General Dixon's deputies commented about the philosophy of the Tactical Air Command (TAC):

> . . . It's all in his [General Dixon's] approach to "train like you fight," and how can you do that unless you work with the Army in every step of what you do all the time, ... [I]t's a matter of us [Air Force personnel] forcing ourselves to understand how the

---

cal Air Defense System: A Description and Analysis (U)" (student paper, Naval Postgraduate School, March 1974), pp. 2-8. (DDC Doc. 530692L.)

[27]"Battle Assessment Techniques Pressed," p. 243.

[28]"Battle Assessment Techniques Pressed," p. 243.

> Army does things, and to get them to understand how we do things, ...[29]

Generally, the Air Force and the Army are progressing rather rapidly in the joint training arena, especially with respect to close air support and the A-10 operation. In the field of air defense, however, joint training is relatively scarce. Readiness Command joint exercises such as Bold Eagle and Brave Shield are the closest to realistic IADS training in which most TAC fighter pilots participate. Even these exercises, however, are so severely limited by range restrictions and scripted scenarios that effective IADS training is questionable.

The innovation and success of TAC's Red Flag combat exercises in November 1975 opened "Pandora's box" to realistic training. Blue Flag, Green Flag, and Black Flag are among the training programs that followed. For tactical aircrews, however, Red Flag remains the leader in realistic combat training despite a noticeable deficiency in its joint IADS training. It was not until November 1977 that IADS training was attempted with the integration of an Army Hawk unit in Red Flag exercises. This is typical of the low priority given joint IADS training, especially in the Continental United States. The following discussion highlights the IADS training problem.

Joint Training Exercises

Annual joint Army/Air Force exercises where the IADS is employed are few in number. Typical of the larger Readiness Command exercises

---

[29] "Dual Challenges Confront TAC," p. 52.

are Brave Shield XVI (14-20 July 1977) and Bold Eagle 78 (22-30 October 1977). In these exercises, Army air defense units and Air Force interceptors were formed into an IADS. The training they received, however, was limited and, in some cases, unrealistic.

In most large exercises, range area, airspace control, and safety considerations constrain planners so that unrealistic IADS rules of engagement and procedures are employed. For example, in Bold Eagle 78, which took place at Eglin Air Force Base, Florida, all aircraft were restricted to subsonic flight within 30 nautical miles of the coastline and all air-to-air intercepts had to be under positive control of the TACS facilities. In addition, all air-to-air activity took place over the water ranges, while surface-to-air forces were employed over land ranges. This fact alone prevented integration of air defense weapons in the same area. Over land, all fighters were restricted to altitudes higher than 700 feet above ground level.[30] Rules and restrictions such as the ones that governed Bold Eagle make IADS training in most large exercises unrealistic.

Despite the restrictive training environment, however, these exercises provide units an opportunity to experience many of the integration problems discussed in previous chapters. For example, the frustration of a C/V battalion trying to integrate into the early

---

[30]Department of the Air Force, Director of Operational Plans, Ninth Air Force (TAC), "AFFOR/OPP-AIR/EXORD 702" (Shaw Air Force Base, S. C., 12 August 1977), pp. C-17-1 through C-17-C-1.

warning nets can be felt in the following excerpt from the afteraction report on Brave Shield XVI by the 1st Battalion, 51st Air Defense Artillery:

> Early warning from any source was virtually nonexistent. The 1st Bn, 51st ADA [Air Defense Artillery], has no FAAR. Out of our own hide, we placed people and commo gear with the Air Force command reporting center [CRC] and with an assault fire unit from Marine Hawk battalion The personnel with the CRC were equipped with the AN/GRC 106 [HFSSB capability]. When the radio did work, we found that the CRC would pass no data to the Army Liaison Officer. He was moved to the command reporting post, a multichannel shot was put in to battalion, and early warning was finally available to the battalion tactical operations center. From there, it went by AN/GRC 106 to the battery. This system is cumbersome and unworkable in a moving situation. . . . Without FAAR, C/V has no effective early warning.[31]

The preceding excerpt is just one example of the problems experienced in joint exercises. A study of Army afteraction reports from joint exercises found that a number of recurring problems plague these exercises. Among the most common are communication troubles, interruption of early warning nets, lack of hostile aircraft markings, and unrealistic kill assessment.[32] These problems, plus the previously mentioned restrictions, illustrate the present unrealistic approach to joint IADS training.

Red Flag

The most realistic and beneficial combat exercise for tactical

---

[31]John D. Crandall, "Brave Shield XVI," Air Defense Magazine, October-December 1977, p. 5.

[32]James F. Bell, "Research Report," Air Defense Magazine, April-June 1977, pp. 4-5.

aircrews training is Red Flag. The unique features that make Red Flag superior to joint exercises for aircrew training are the range area, rules of engagement, and realistic threat simulators. Despite Red Flag's outstanding capability and results, Red Flag is grossly lacking in IADS training. Of particular concern is the void of IADS employment and the almost totally offensive orientated scenarios.

The Red Flag exercise area is one of the largest combined ground and air ranges in the Continental United States. It extends 140 miles north of Nellis Air Force Base, Nevada, and is about 170 miles wide.[33] The Government owns most of the land, so unrestricted supersonic low altitude operations are permitted. This is essential for realistic training since General Dixon and TAC have acknowledged that the next war will probably be fought at low altitude.[34] Unlike Readiness Command exercises, Red Flag's minimum altitude restrictions are compatible with current fighter tactics and aircrew proficiency (below 200 feet above ground level).

Rules of engagement for opposing forces are more realistic. Positive radar control is not a mandatory prerequisite for intercepts or engagements. Airspeed and altitude restrictions in Red Flag are minimal, and pilots are encouraged to try innovative tactics. The opposing

---

[33]"Red Flag Stresses Realism in Training," Aviation Week & Space Technology, 6 February 1978, p. 188.

[34]"Requirements Concepts Keyed to Mission Area Analysis," Aviation Week & Space Technology, 6 February 1978, p. 62.

forces in Red Flag are made up of the most realistic Soviet simulated weapons found outside the Iron Curtain. Everything from 23mm and 57mm gun platforms to surface-to-air missiles to F-5Es simulating MIG-21s are found on the Red Force side.[35]

Red Flag is an excellent facility for realistic training, but improvement in some areas would make Red Flag even more effective. Scenario development in Red Flag is stagnant and outdated, especially for IADS training. Most scenarios harken back to the composite strike forces of the Vietnam era. Offensive air base attack, deep interdiction, and close air support scenarios comprise the majority of the missions. The Red Forces in Red Flag exercises (Aggressor Squadrons) are given the task of designing an enemy IADS and conducting a defensive counterair campaign. Currently sophisticated SAM simulators are integrated into a Soviet air defense system with elaborate East German airfields reconstructed on the target ranges.[36] Blue Force air defense scenarios occur intermittently, while air defense integration with Army units is practically nonexistent. Unfortunately, given the current Soviet tactical air doctrine, Soviet numerical superiority, and the distinct possibility the United States will be engaged in a defensive counterair battle in Europe, Red Flag forces are fighting the wrong war. Aggressor forces are becoming proficient in IADS employment, yet they

---

[35]"Red Flag Stresses Realism in Training," p. 186.

[36]"Red Flag Stresses Realism in Training," p. 188.

should be simulating air base attack. F-15 pilots are training in offensive fighter sweeps and interdiction escort, yet they should be practicing air defense integration.

As stated earlier, Army air defense units are just beginning to become involved in Red Flag exercises. Units from the 11th Air Defense Artillery Group from Fort Bliss, Texas, joined units from the 727th Tactical Control Squadron from Bergstrom Air Force Base, Texas, in November 1977 to participate in Army maneuvers (Devil Strike) and Red Flag 78-1 and 78-2. This was the first time Army air defense units participated in Red Flag. The IADS was established at the Fort Irwin, California, range, a small Army range adjacent to the large Red Flag Nellis complex. It consisted of a mini-CRC (one cell of the AN/TSQ-91 (V)), an AN/TPS-43E radar, and a Hawk unit. Major Jim Burns, Operations Officer, 727th Tactical Control Squadron, explains the benefits realized by the initial attempt at Red Flag IADS training in the following excerpt from his afteraction report:

> . . . The major benefit experienced in Red Flag 78 1&2 was that the combined talents and experience of individual members were applied to realize the potential of the mini-CRC. Red Flag exercises provide a forum where contemporary concepts, tactics, and techniques can be tried within the bounds of generalized guidance. Personnel and equipment were adapted to a conception of what a realistic combat environment would be. The lack of scripted scenarios with scripted outcomes provided an unusual opportunity to experiment with new concepts, tactics, and techniques. That is not to say that tried and proven procedures were abandoned. However, the latitude to recognize and react to the tactical situation, to innovate where necessary was a welcomed opportunity. Interaction of all the TACS elements and aircrews was dynamic and not necessarily bound by the constraints normally experienced in a somewhat

artificial exercise environment. . . .[37]

Despite the major benefit of an unrestricted training environment, the Red Flag IADS had to contend with many problems. For example, the Red Flag TACC was inadequately staffed and poorly prepared to monitor and support the CRC at Fort Irwin. Communications between the CRC, TACC, and tactical unit operations centers were inadequate. The FACP personnel and the ADALO who manned the CRC were not familiar with the AN/TSQ-91 (V) equipment and procedures. The Fort Irwin range complex was too small to conduct realistic and effective operations. Communication problems existed between the CRC and Hawk unit, as the TSQ-73 was not used and target information had to be passed manually between the CRC and the BCC.[38]

Due to these and other problems, bastardized procedures were employed out of operational necessity. In discussing this fact, Major Burns states:

> The manual mode of operations required that substantial chances [changes] be made in the coordination and execution of integrated counter air operations. The need to rapidly recognize and react to the tactical situation in a high density/high threat environment resulted in extensive modification of classic TACS procedures. For example, the ADALO was delegated authority to identify, initiate tactical action, and engage non-friendly aircraft within the improved HAWK's area of coverage using information and equipment capabilities available in the Operations Central. Coordination was effected with the Weapons Assignment Officer-WAO. Concurrent operations were carefully orchestrated between defensive air weapons

---

[37]DAF, 727th Tac Con Sq (TAC), p. 7.

[38]DAF, 727th Tac Con Sq (TAC), pp. B-1 through B-6.

controllers and the ADALO.[39]

Another IADS procedure modified in Red Flag was the method in which the ADALO passed early warning information to the Hawk units. In the words of Major Burns:

> Initially the ADALO passed engagement information to the BCC in GEOREF. This system is cumbersome, inaccurate because of cumulative errors, and lacks the flexibility necessary to react in a time compression situation. After some investigation it was determined that the BCC had an electronic cursor which was capable of providing azimuth in mils and range in kilometers. The TACS equipment can provide cursor azimuth in degrees and range in nautical miles. The TACS cursor also was [has] a feature where by [sic] a track can also be integrated and its modes/codes determined simultaneously. By placing the TACS cursor over the known site location of the BCC the ADALO was capable of rapidly providing timely and accurate information on the position, identification, and number of targets to the BCC. A simple conversion system from degrees to mils and nautical miles to kilometers was used which significantly improved the timely acquisition and engagement of non-friendly tracks. After experience was gained with this procedure it was adopted as the primary mode of operation for the remainder of the exercise. This procedure also facilitated the engagement of aircraft when the HAWK acquisition radar was inoperative. In addition, the clarity of the TPS-43E information also facilitated the engagement of specific aircraft in a flight or air-to-air engagement. This capability has not been available with other systems.[40]

The Red Flag environment can thus be seen as providing an excellent opportunity for concentrated and expanded IADS training. The report by Major Burns concludes with the following recommendation:

> It was evident during the course of exercise conduct that a closer working relationsnip is required between TACS/ADA units. Joint training should be improved and expanded both in preparation for the exercise and during exercise execution. The increasing complexity of TACS/ADA capabilities and limitations be developed to

---

[39] DAF, 727th Tac Con Sq (TAC), p. B-1-3.

[40] DAF, 727th Tac Con Sq (TAC), pp. B-1-3 & B-1-4.

ensure that these units can work effectively toward attainment of common goals. Recommend that a TACS Orientation Course be developed for ADA Liaison Teams and that an ADA Orientation Course be developed for TACS Weapons Teams. This approach would provide the requisite experience base to facilitate closer team work in the anticipated combat environments of the future.[41]

Conclusions

In examining the major IADS command and control facilities, it was discovered that the equipment has many limitations which hinder the integration process. Many of the IADS operational centers are still basic manual systems with time-consuming manual plotting and unreliable voice communication networks. The joint services are attempting to rectify this situation with new automated data-link systems such as TSQ-73 and JTIDS.

The IADS weapons inventory is undergoing a similar major modification program. All Air Force and Army current air defense weapons are being replaced by systems that will sustain the IADS through the 1980s. As the F-15, F-16, Patriot, Roland, and Stinger become incorporated into operational units, their greatly improved capabilities call for a reevaluation of the present employment doctrine and procedures. Although these new weapons have superior capabilities, the same integration problems remain unresolved.

Finally, in the IADS training discussion, it was concluded that current joint service IADS training is conducted too infrequently and is

---

[41]DAF, 727th Tac Con Sq (TAC), pp. B-1-4 & B-1-5.

unrealistic in most exercises. Joint exercises such as Readiness Command exercises do not provide adequate realistic IADS training. Their scenarios are extremely stereotyped to the offensively oriented tactical employment doctrine, while rules of engagement are unrealistic and highly restrictive due to range area, airspace control, and safety constraints. The recent use of Red Flag exercises for IADS training has solved some of these problems. Rules of engagement are more realistic, and innovative tactical employment is encouraged. Some problems with Red Flag IADS training must be remedied, however. The scenarios are too offensively oriented toward air base attack. The range area at Fort Irwin is too small to conduct proper IADS training. These and other training problems are not insurmountable, especially if the proper emphasis is placed on tactical air defense integration.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Several significant events of the past decade have required the United States to reassess its integrated air defense doctrine and capabilities. These events include the Vietnam War, the 1973 Middle East War, and the change in Soviet tactical air doctrine and capabilities. The North Vietnamese air war over Hanoi demonstrated that an integration of jet aircraft, surface-to-air missiles, and conventional antiaircraft guns can be highly effective in defeating or harassing a superior enemy.

The experience by the Arab Forces in the 1973 Middle East War reinforced many of the outcomes found in Vietnam. Integrated air defense proved once again to be a decisive factor in air battles. Although the Israelis were eventually considered victorious, the effectiveness of the Arab air defenses surprised even the Israelis. These two wars demonstrated that a well-integrated air defense can degrade a strong offense or can at least make offensive tactical air operations extremely expensive.

The two wars also provided insights into the different techniques used for integrating air and ground defensive weapons in combat Although the Soviet Union trained and supplied all three defenders--the

North Vietnamese, the Syrians, and the Egyptians--each defender's integration tactics differed. The North Vietnamese used a highly centralized and integrated command and control system in which they employed interceptors sparingly and only on the fringes of the SA-2 and antiaircraft artillery envelopes. The system was so well integrated after eight years of war that interceptors could be used as bait and decoys to lure the enemy into the missile and antiaircraft artillery belts.

The Egyptians and Syrians, using more sophisticated weapons, were not able to integrate their interceptors as effectively as the North Vietnamese. The Egyptians attempted to rely primarily on their surface-to-air weapons. They used their interceptors outside the missile belts only when it was absolutely necessary. This strategy worked initially; however, once the Egyptians were forced to commit their interceptors inside the missile belts, the number of aircraft lost to friendly fire rose sharply. On the basis of sketchy reports, the Syrians attempted to solve the fratricide problem through identification, friend or foe (radar) (IFF) procedures. They permitted friendly aircraft operations inside the Golan missile belt, but they, too, experienced a significant friendly loss rate.

In the past decade, tactical air defense has come into its own as a state of warfare. Obviously, air defense alone cannot win a war. If the enemy is powerful enough and is willing to absorb high loss rates, air defenders will find it difficult to hold out indefinitely in the absence of superior offensive combat power. Regardless of whether

offense or defense dominates, the integration of air and surface defensive weapons is extremely important to the overall outcome of the air battle.

Historical lessons of the employment of a modern integrated air defense system (IADS) in combat become even more significant when one considers the Soviet buildup of tactical air forces and the changing Soviet doctrine. Technological advances in Soviet offensive tactical air capability during the past decade have been astonishing. Deployment of the Fencer-A, Flogger-D, and Fitter-C has given Soviet Frontal Aviation forces the capability to strike deeper targets with larger payloads. This threat will probably ingress at low altitudes and high speeds in mass wave attack tactics. The Soviet tactical air power, always strong defensively, is now challenging United States rear-basing areas with a new offensive tactical air arm of unquestionable sophistication.

Even more threatening is the Soviet doctrinal metamorphosis from a defensive posture toward an offensive tactical air strategy. In the past decade, Frontal Aviation forces have been given increasing responsibility in all phases of offensive operations. Offensive targets such as enemy nuclear delivery systems and air bases, which in the past were reserved for Soviet rocket troops, are now primary targets for Frontal Aviation aircraft. This places the United States Air Force in a position where it must be able to conduct an offensive counterair campaign and also coordinate an effective IADS against a determined enemy.

Conclusions

The change in Soviet offensive capability and the recent historical reemergence of air defense potency have necessitated an examination of the United States tactical IADS. This research effort has revealed six major conclusions concerning the present IADS status. The first and perhaps most important conclusion is that tactical air defense is not given proper emphasis in current Air Force doctrine. Although the Air Force has primary responsibility for developing integrated air defense doctrine, it has been remiss in fulfilling this responsibility. Events of the past decade plus the Army's change to the "Active Defense" doctrine have placed the Air Force in the awkward position of being challenged on its doctrinal development.

The second major conclusion is that the present IADS organizational lines of control and communication are extremely centralized. Although the North Vietnamese demonstrated that a well-organized IADS with centralized control can be highly effective, an overriding disadvantage to centralization is that lines of weapons control and communication become complex and cumbersome. The integration of United States air defense weapons employment is highly centralized in the control and reporting centers (CRCs). With present equipment, the CRCs can effectively integrate interceptors and Hawk units only if the TSQ-73 is available. In cases where positive control is not assured, such as in manual Hawk employment (without TSQ-73) and in all short-range air defense (SHORAD) employment, the Air Force Component Commander (AFCC)

and his staff establish extremely restrictive rules of engagement. This centralized organization reduces flexibility of IADS weapons integration and prohibits autonomous bilateral operations, that is, operations such as the F-15/Hawk or the F-15/SHORAD employment without CRC control.

The third conclusion is that restrictive IADS rules of engagement and standard operating procedures restrain integration flexibility. Reliance on these rules and procedures is necessary to accommodate integration deficiencies, but some rules and procedures are grossly unrealistic and would be disastrous in a high threat environment. Employment procedures such as weapon engagement zones and safe passage corridors, which place friendly fighters at medium altitude over the forward edge of the battle area, are unrealistic in today's environment. Weapon engagement zones would also inhibit air defense battle managers who were employing the concept of mix and mass of air defense weapons. Additionally, universal weapons tight status for SHORAD weapons severely limits their employment throughout the theater of operations. These rules and procedures are designed to control the fratricide problem; however, their enforcement severely restricts integrated employment flexibility in the system.

The fourth conclusion is that the IADS command and control equipment is inadequate to support a totally integrated air defense system. The most important integration breakthrough to date is the development of the TSQ-73, which allows Air Force/Hawk real-time integration. The SHORAD units, however, are still completely on their own

as far as target early warning, acquisition, and identification. Interceptors are at the mercy of the CRCs, because at present no direct communication capability exists between the F-15 and Army air defense artillery units.

The IADS weapons themselves are also inadequate to support a totally integrated system. Fortunately, an extensive modernization program is correcting this fifth conclusion. Until the new weapons are deployed, however, present weapons, although capable, do not lend themselves to effective integration tactics. There is no capability to operate an integrated system in a totally all-weather environment. All of the present SHORAD weapons--Chaparral, Redeye, and Vulcan--are strictly visual target acquisition and identification weapons. Even the F-15 and the Hawk, which have IFF capability, still rely on visual identification as one of their primary means of target verification. Another problem associated with the F-15 modernization is that the Air Force must come to grips with the quantity versus quality matter in F-15 employment. Further, the Air Force must consider the impact of replacing the F-4E with the F-16, an aircraft that does not have an all-weather intercept capability.

The sixth and final conclusion is that IADS joint training is presently too scarce and unrealistic. The annual joint exercises, such as Bold Eagle and Brave Shield, do not incorporate realistic rules of engagement due to range area, airspace, and safety constraints. The joint exercise scenarios and training environment are too inflexible to

allow tactics innovition and experimentation. While Red Flag exercises have eliminated some of these problems, major problems remain. For instance, the emphasis in Red Flag is still on offensive air base attack and composite force deep interdiction scenarios. IADS employment is rarely played in Red Flag, and only then at the smaller adjacent Fort Irwin range. While offensive counterair and interdiction operations still warrant exercising in the joint environment, the overwhelming numerical superiority and doctrinal change in Soviet Frontal Aviation demand that a greater emphasis be placed on defensive counterair scenarios. The meager attempts to date to employ a fully integrated IADS in the joint environment have shown that the United States is ill-prepared to fight an intensive defensive counterair battle with today's equipment and training.

Recommendations

This thesis has dealt with the general topic of integrated air defense. The conclusions lead to one major recommendation: The Air Force and the Army should place more emphasis on integrated tactical air defense. Given the significant events that have occurred within the past decade, the Air Force, especially, should recognize the future importance of tactical air defense. The processes of air defense integration are complex and will require extensive future cooperation, development, and training.

Beyond this general recommendation, several more specific recommendations follow. In particular, this writer recommends that:

1. The Air Force and the Army publish a joint tactical air defense operational doctrine manual.

2. The Air Force examine present doctrine to determine if increased emphasis needs to be placed on defensive capabilities and air strategy in the light of the threat.

3. The Army revise sections in its air defense artillery employment manuals (44 series) that deal with integration doctrine and interceptor employment to align them with present capabilities.

4. Both services reevaluate the IADS rules of engagement and procedures to provide more flexibility in integration employment.

5. Both services procure additional control equipment such as UHF radios for Army air defense artillery, FM radios in aircraft, and better SHORAD early warning equipment to provide increased decentralized integration capabilities.

6. Both services accelerate their weapons modernization programs.

7. The Air Force consider modifying a portion of the F-16 swing-force with an all-weather intercept capability.

8. The Readiness Command change its joint exercise procedures to provide more realistic IADS training.

9. Red Flag managers revise their scenarios and deployments to incorporate more IADS training. A permanent IADS facility with operational tactical air control center (Air Force), control and reporting center, Hawk, and short-range air defense units should be set up on the

Nellis range complex.

10. Both services should initiate a joint IADS training school for weapons controllers, Army air defense artillery officers, and fighter pilots.

11. Brief (one-week) interservice exchanges should be arranged for weapons controllers, Army air defense artillery officers, and fighter pilots.

APPENDIX

APPENDIX: GLOSSARY OF ACRONYMS SHOWN IN FIGURES

AADCP: Army Air Defense Command Post

AD: air defense

ADA: air defense artillery

ADALO: Air Defense Artillery Liaison Officer

ALCC: airlift control center

AM: amplitude modulated

ASRT: air support radar team

BCC: battery control central (Army)

BOC: battalion operations center (Army)

CP: command post

CRC: control and reporting center

CRP: control and reporting post

C/V: Chaparral/Vulcan

CWAR: continuous wave acquisition radar

DASC: direct air support center

DEFCON: defense readiness condition

DTOC: division tactical operations center

ECM: electronic countermeasures

EW: early warning

FAAR: forward area alerting radar (Army)

FACP: forward air control post (Air Force)

FCC: flight coordination center

FEBA: forward edge of the battle area

FEZ: fighter aircraft engagement zone

FM: frequency modulated

GEOREF: World Geographic Reference System

HIMEZ: high-missile engagement zone

HIPAR: high power acquisition radar

LCG: launching control group

LOMEZ: low-missile engagement zone

LOPAR: lower power acquisition radar

MSL: mean sea level

MTR: missile tracking radar

PAR: pulse acquisition radar

PCP: platoon command post

RATT: radio teletypewriter

RTO: radio telephone operator

TAC: Tactical Air Command

TAC(A): tactical air coordinator (airborne)

TACC: tactical air control center (Air Force)

TCO: Tactical Control Officer

TOC: tactical operations center

TRR: target ranging radar

TTR: target tracking radar

TUOC: tactical unit operations center (fighter operations)

BIBLIOGRAPHY

BIBLIOGRAPHY

Government Documents

Brown, George S. United States Military Posture for FY 1978. Washington: Government Printing Office, 1977.

Department of Defense. Functions of the Department of Defense and Its Major Components. DOD Dir 5100.1. 31 December 1958.

_____. Joint Chiefs of Staff. Doctrine for Air Defense From Overseas Land Areas. JCS Pub 8. May 1964.

Department of the Air Force. United States Air Force Basic Doctrine. AFM 1-1 (DRAFT). 20 May 1977.

_____. Tactical Air Control System (TACS): Surveillance and Control of Tactical Air Operations. TACR 55-44. 20 March 1975.

_____. Air Force Component Headquarters and Tactical Air Control Center Operations. TACR 55-45. 7 February 1975.

_____. United States Air Force Basic Doctrine. AFM 1-1. 15 January 1975.

_____. Tactical Air Force Operations--Tactical Air Control System (TACS). AFM 2-7. 25 June 1973.

_____. Tactical Air Operations--Airspace Control in the Combat Area. AFM 2-12. 2 April 1973.

_____. Tactical Air Operations: Airspace Control in an Area of Operations. TACM 2-1. 17 March 1972.

_____. Tactical Air Operations--Counterair, Close Air Support, and Air Interdiction. AFM 2-1. 2 May 1969.

_____. Atlantic Command Headquarters. Air Control/Air Defense Procedures Manual for Solid Shield 77 (TACS/TADS OED) (U). Norfolk, Va., 15 March 1977.

_____. Director of Operational Plans, Ninth Air Force (TAC). "AFFOR/OPP-AIR/EXORD 702." Shaw Air Force Base, S. C., 12 August 1977.

_____. 727th Tactical Control Squadron (TAC). "After Action Report of Detachment 1, 727 Tactical Control Sq for Red Flag 78 1-2 (U)." Prepared by James E. S. Burns. Bergstrom Air Force Base, Tex., 10 January 1978.

_____. Tactical Air Command. Tactical Air Control System (TACS): Tactical Control Procedures. TACM 55-60. 21 January 1974.

_____. _____. Tactical Air Control System Equipment. TACP 55-43. Langley, Va., 28 September 1973.

_____/CINCUSAFE/DO&I. Salty Control (U). June 1976.

_____/Department of the Army. US Air Force/US Army Airspace Management in an Area of Operation. AFM 2-14/FM 100-42. 1 November 1976.

_____. Doctrine and Procedures for Airspace Control in the Combat Zone. AFM 1-3/FM 100-28. 1 December 1975.

Department of the Army. U.S. Army Air Defense Artillery Employment: Hawk. FM 44-90. 30 November 1977.

_____. U.S. Army Air Defense Artillery Employment: Chaparral/Vulcan. FM 44-3. 30 September 1977.

_____. U.S. Army Air Defense Artillery Employment: Redeye. FM 44-23. 30 September 1977.

_____. Operations. FM 100-5. 1 July 1976.

_____. U.S. Army Air Defense Artillery Employment. FM 44-1. 26 March 1976.

_____. Foreign Science and Technology Center. "Tactics and Organization of Soviet Ground Forces Different Parts." Translated by R. Lagerwerft. Charlottesville, Va., 1974. (DDC Doc. AD B001901L.)

_____. Office of the Assistant Chief of Staff for Intelligence. Military Operations of the Soviet Army. USAITAD Report No. 14-U-76. 1976.

_____. U.S. Army Air Defense School. Air Defense Artillery Reference Handbook. 1977.

Hill, William B. (ed.). Guide for Air Power Case Study: Linebacker I and II. Area III, Course 1975-76, Instruction Period 3107. Air War College, Department of Military Strategy, n.d.

Sharp, U. S. G., and W. C. Westmoreland. Report on the War in Vietnam. Washington: Government Printing Office, 1969.

U.S. Congress. House. Committee on Appropriations. Subcommittee on Department of Defense. Briefings on Bombings of North Vietnam, Hearings. Committee Print, 93d Cong., 1st sess., March 1973. (Congressional Information Service, Microfiche H181-1.)

U.S. Army Command and General Staff College. U.S. Air Force Basic Data. RB 110-1. July 1977.

_____. Selected Readings in Tactics: The 1973 Middle East War. RB 100-2. August 1976.

Books

Ahmed Ali M. Amer (ed.). Military Sector. Vol. I of The Book of the International Symposium on the 1973 October War: Cairo, 27-31 October 1975 Proceedings. Cairo: Ministry of War, 1976.

Broughton, Jack. Thud Ridge. Philadelphia: J. B. Lippincott Company, 1969.

Editors of Aviation Week & Space Technology. Both Sides of the Suez: Airpower in the Mideast. [New York: McGraw-Hill, 1975.]

Herzog, Chaim. The War of Atonement, October 1973. Boston: Little, Brown and Company, 1975.

Insight Team of the London Sunday Times. The Yom Kippur War. Garden City, N. Y.: Doubleday & Company, Inc., 1974.

Menaul, S. W. B., and Bill Gunston. Soviet War Planes. London: Salamander Books, Ltd., 1977.

Mohamed Heikal. The Road to Ramadan. New York: Quadrangle/New York Times Book Co., 1975.

Palit, D. K. Return to Sinai: The Arab Offensive, October 1973. Dehra Dun, New Delhi: Palit & Palit, 1974.

Sidorenko, A. A. The Offensive (A Soviet View). Moscow, 1970. (Translated and published under the auspices of the United States Air Force [1973].)

Sokolovskiy, V. D. Soviet Military Strategy. Edited by Harriet Fast Scott. New York: Crane, Russak & Company, Inc., 1975.

Strategic Survey, 1974. London: International Institute for Strategic Studies, 1975.

Strategic Survey, 1973. London: International Institute for Strategic Studies, 1974.

Van Dyke, Jon M. North Vietnam's Strategy for Survival. Palo Alto, Calif.: Pacific Books, 1972.

White, William D. U.S. Tactical Air Power: Missions, Forces, and Cost. Washington: Brookings Institution, 1974.

Wiener, Friedrich. The Armies of the Warsaw Pact Nations. Translated by William J. Lewis. Vienna: Carl Ueberreuter, 1976.

Williams, Louis (ed.). Military Aspects of the Israeli-Arab Conflict. Tel Aviv: University Publishing Projects, 1975.

Articles and Periodicals

Addington, Larry H. "Antiaircraft Artillery vs. Fighter-Bomber." Army, December 1973, pp. 18-20.

"Airpower Provides Viet Leverage." Aviation Week & Space Technology, 30 October 1972, pp. 12-13.

"Antiaircraft Defense in North Vietnam." (Pp. 55-71 in the magazine Norsk Artilleri-Tidsskrift, No. 3, 1974, which was translated and repaginated as pp. 1-18 by Leo Kanner Associates, Redwood City, Calif., 30 September 1975. DDC Doc. AD B009853L.)

"Battle Assessment Techniques Pressed." Aviation Week & Space Technology, 6 February 1978, p. 243.

Bearden, Thomas E. "What Really Happened in the Air Defense Battle of North Vietnam." Air Defense Magazine, April-June 1976, pp. 8-15.

Bell, James F. "Research Report." Air Defense Magazine, April-June 1977, pp. 4-5.

Brownlow, Cecil. "North Viets Intensify Combat Capabilities." Aviation Week & Space Technology, 8 July 1968, pp. 14-16.

"Can Soviet Aircraft Penetrate NATO's Air Defense?" Electronic Warfare, May-June 1977, pp. 57-62.

Crandall, John D. "Brave Shield XVI." Air Defense Magazine, October-December 1977, pp. 4-5.

"Dual Challenges Confront TAC." Aviation Week & Space Technology, 6 February 1978, pp. 49-56.

Dumbrique, Alex. "The Need for Adequate Division Air Defense Command and Control." Air Defense Magazine, October-December 1976, pp. 18-21.

Düsseldorf, Peter Borgart. "The Air Attack Potential of the Warsaw Pact." Air Defense Magazine, October-December 1976, pp. 6-11.

Eade, George J. "Reflections on Air Power in the Vietnam War." Air University Review, November-December 1973, pp. 3-9.

Ebel, Wilfred L. "Japan's Developing Army." Military Review, April 1978, pp. 29-33.

"ECM Stymies North Viet SAMs." Aviation Week & Space Technology, 24 April 1972, pp. 14-15.

Elson, Benjamin M. "TAC Readies for Deployment of E-3A." Aviation Week & Space Technology, 6 February 1978, pp. 105-112.

Erickson, John. "Soviet Military Capabilities in Europe." Military Review, January 1976, pp. 58-65.

Fink, Donald E. "Flight Tests Confirm New Missiles Need." Aviation Week & Space Technology, 6 February 1978, pp. 85-89.

Gray, Colin. "Soviet Tactical Airpower." Air Force Magazine, March 1977, pp. 62-71.

Greenhut, Jeffrey. "Air War: Middle East." Aerospace History, March 1976, pp. 21-23.

Hill, Adrian. "Air War Over Vietnam." Journal of the Royal United Services Institute for Defence Studies, December 1976, pp. 27-28.

Hotz, Robert. "New Lessons from Vietnam." Aviation Week & Space Technology, 22 May 1972, p. 7.

Karikh, A. "Fighting Against Low-Flying Targets." Soviet Military Review, December 1974, pp. 16-19.

Keiji, Teramoto. "The Air Combats I Witnessed in North Vietnam." (Pp. 10-11, 44-45, & 93-95 in the magazine Koku Fan, Vol. 20, No. 1, 1971, which the Air Force Foreign Technology Division translated, edited, and repaginated as pp. 1-16, 3 October 1972. DDC Doc. AD 904872L.)

Konyukhov, A. "Training of Air Snipers." Soviet Military Review, March 1974, pp. 16-17.

"Major Command Tactical Air Command, A." Air Force Magazine, May 1977, pp. 82-83.

Marriott, John. "Roland II." NATO's Fifteen Nations, April-May 1975, pp. 100-102.

Momyer, William W. "Momyer Cites Viet's Tactical Lessons--2." Aviation Week & Space Technology, 4 June 1973, pp. 59-61.

_____. "Tactical Lessons of Vietnam--1." Aviation Week & Space Technology, 21 May 1973, p. 7.

O'Ballance, Edgar. "Air Defence of North Viet-Nam." Marine Corps Gazette, November 1950, pp. 78-79.

Parker, Russel W. "Air Defense: The Excalibur of the Corps and Division Commanders." Air Defense Magazine, April-June 1976, pp. 16-21.

Peterson, L. C. "Vindication of the SAM." Ordnance 51 (May-June 1967): 583-86.

Piroti, C. "Surface-to-Air Artillery Material from Viet-Nam and the Mid-East." (Pp. 46-51 in French Armed Forces Magazine, April 1975, which Leo Kanner Associates, Redwood City, Calif., translated and repaginated as pp. 1-11. DDC Doc. AD B013716L.)

"Red Flag Stresses Realism in Training." Aviation Week & Space Technology, 6 February 1978, pp. 186-189.

"Requirements Concepts Keyed to Mission Area Analysis." Aviation Week & Space Technology, 6 February 1978, pp. 62-63.

"Roland Weapon System Reaches Production Stage." Military Review, March 1978, p. 101.

Sella, Amnon. "The Struggle for Air Supremacy, October 1973 - December 1975." Journal of the Royal United Services Institute for Defence Studies, December 1976, pp. 31-36.

Simler, George B. "Nortn Vietnam's Air Defense System." Air Force/ Space Digest, May 1967, pp. 81-82.

Ulsamer, Edgar. "USAF Prepares for Future Contingencies." Air Force Magazine, June 1973, pp. 34-40.

"USSR, Pact, and PRC General Purpose Force Capabilities." Commanders Digest, 29 April 1976, pp. 1-8.

Weinraub, Bernard. "Air Attack 'Threat' to NATO: West Vulnerable to Soviet Strike, Brookings Finds." Kansas City Times, 30 January 1978, p. 8A.

Young, S. M. H. "Gallery of USAF Weapons." Air Force Magazine, May 1977, pp. 116-30.

Reports

Armitage, W. F., and B. L. Renniger. "Air Defense in the NATO Allied Command Europe Central Region--Current Capabilities (U)." Project No. 6410. Bedford, Mass.: MITRE Corp., 28 February 1975.

Bordeaux, T. A. "Comparison of U.S. and USSR Land-Based Battlefield Air Defense Systems (U)." Report No. RDA-TR-5500-003. Santa Monica, Calif.: R & D Associates, May 1974.

Canby, Steven L. "Tactical Airpower in Europe: Airing the European View (U)." Report No. TSC-PD-471-1. Santa Monica, Calif.: Technology Service Corporation, 19 July 1976.

Dews, E., and others. "Tactical Airpower in a Mid-Seventies NATO Defensive Contingency (NATO ALPHA) (U)." Santa Monica, Calif.: RAND Corp., October 1974. (DDC Doc. AD1000156L.)

Gershon, Gordon M. "Tactical Air Defense Evaluation Study (TAD-E), Subtask 6--Analysis of SHORAD Weapon Systems: Command and Control Alternatives (U)." Menlo Park, Calif.: Stanford Research Institute, May 1974. (DDC Doc. AD 530688L.)

Wolfe, Thomas W. "Recent Soviet Literature on Tactical Air Doctrine and Practice (U)." Report No. RM-6336-PR. Santa Monica, Calif.: RAND Corp., July 1970.

Unpublished Material

"Air Defense and Air Superiority." Draft Annex ____. n.p., n.d. (USACGSC Library Doc. N-18090.3.)

Blanch, Claude C. "Air Superiority Today and Tomorrow." Report No. 5847, Air War College, April 1976. (DDC Doc. AD B011430L.)

Brown, Charles J., and Johnnie R. Reeder. "The Development of Counter-air Doctrine." Research Report No. 5858, Air War College, April 1976. (DDC Doc. AD B011161.)

Drane, Leslie R., Jr. "Soviet Tactical Air Doctrine." Report No. 5894, ir War College, April 1976.

Koblitz, Ronald Dean. "The Tactical Air Control System, Tactical Air Defense System: A Description and Analysis (U)." Student paper, Naval Postgraduate School, March 1974. (DDC Doc. 530692L.)

Thompson, Ray G. "An Alternative NATO Air Strategy of Defensive Operations." Student paper, U.S. Army War College, 16 March 1972.

VITA

VITA

Michael C. Press was born in Los Angeles. In 1965 he graduated from the University of Oregon as a distinguished ROTC graduate and received a Bachelor of Science degree. He was commissioned into the United States Air Force as a regular officer in 1965. Lieutenant Press graduated pilot training number one in his class and received the Air Training Command Commander's Trophy. Following graduation, Lieutenant Press spent two years in Germany flying the F-4D. In 1969 Captain Press flew a combat tour in the OV-10 in Southeast Asia, accumulating 480 combat missions.

In 1970 Captain Press was assigned to the Tactical Air Command at MacDill Air Force Base, Florida, as an F-4E instructor. From there, in 1972, he was assigned to the 57th Fighter Weapons Wing, Nellis Air Force Base, Nevada, where he was an original member of the first Aggressor Squadron. At Nellis, while flying the F-5E he participated in numerous Tactical Fighter Weapons Center tactics development and evaluation (TD&E) tests for fighter aircraft. He also participated in many Red Flag exercises plus the F-15, F-16, A-10, and AWACS initial operational tests and evaluations (IOT&E).

In 1977, Major Press was selected to attend the United States Army Command and General Staff College, Fort Leavenworth, Kansas.

Following his graduation, Major Press was assigned to the Military Assistance Advisory Group (MAAG), Teheran, Iran, as the United States advisor to the Imperial Iranian Air Force for F-5E operations.